28th
EDITION

MOTOR CYCLES

and

HOW TO MANAGE THEM

THE MOTOR CYCLE

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28th EDITION

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FOREWORD

THE object of this book, as indeed its title implies, is to tell readers everything they are likely to want to know about motor cycles and their care and maintenance. Its scope is wide. It begins with a simple description of how an engine works, passes on to discuss different types of power unit, the construction and methods of operation of the various components, how to ride a solo motor cycle or drive a sidecar outfit and three-wheeler, and then to questions of choosing a suitable machine, buying it, and obtaining the necessary licences and insurance policy.

Even this does not summarise its contents properly; there is also a dozen or more chapters of helpful advice on carrying out running adjustments, and others dealing with fault-finding and little legal points which are well worth knowing.

The whole book has been written with the object of being " understandable ". While it is simple in phraseology it contains the accumulated knowledge of years of practical experience and hundreds of hints and tips.

To answer in a single book *every* question that may crop up in the mind of a motor cyclist or potential motor cyclist, or all the problems with which he may be faced, is obviously impossible. Therefore, may we invite you to remember that *The Motor Cycle* and its staff are always at your service—to solve your motor cycle problems and give you helpful, friendly advice? We enjoy being of assistance ; all we ask is that the letters shall be accompanied by stamped, addressed envelopes ready for the replies.

If you are a newcomer to our ranks we hope you will enjoy motor cycling as much as we do.

The Editor,
The Motor Cycle

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MOTOR CYCLES AND HOW TO MANAGE THEM

CHAPTER I

HOW THE ENGINE WORKS

The Four-Stroke and Two-Stroke Cycles

IN these days hundreds of thousands know the rudiments of the petrol engine and "what makes the wheels go round". If you are already conversant with the way in which both two-stroke and four-stroke engines work, then by all means skip this chapter and pass on to the next, which describes and discusses the various engine components.

The method of operation of an engine is easily grasped. The main essentials of a single-cylinder engine are a piston, which slides up and down inside a cylinder (visualise a jam-pot upside down), a crank, and a connecting rod, which "connects" the piston with the crank. Figure 1 shows these parts in diagrammatic form. We have only to imagine the piston pushed downwards to realise that

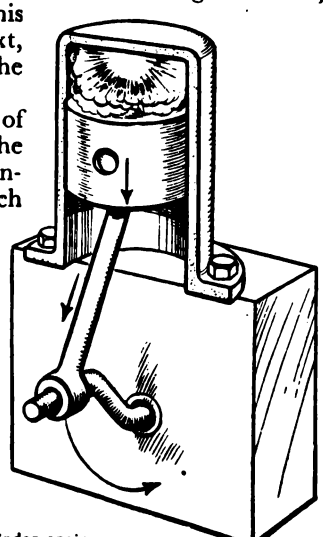


Fig. 1 : The essentials of a single-cylinder engine

when an explosion occurs in the cylinder the crank revolves automatically.

A second glance at the diagram reveals that for every complete revolution made by the crank the piston makes two strokes, one downward and the other upward. This provides a clue to the meaning of the terms " two-stroke " and " four-stroke ". In the case of the former type of engine there is one explosion for every *two* strokes of the piston, i.e., for every revolution of the crank, and with the latter type one explosion every *four* strokes. Thus,

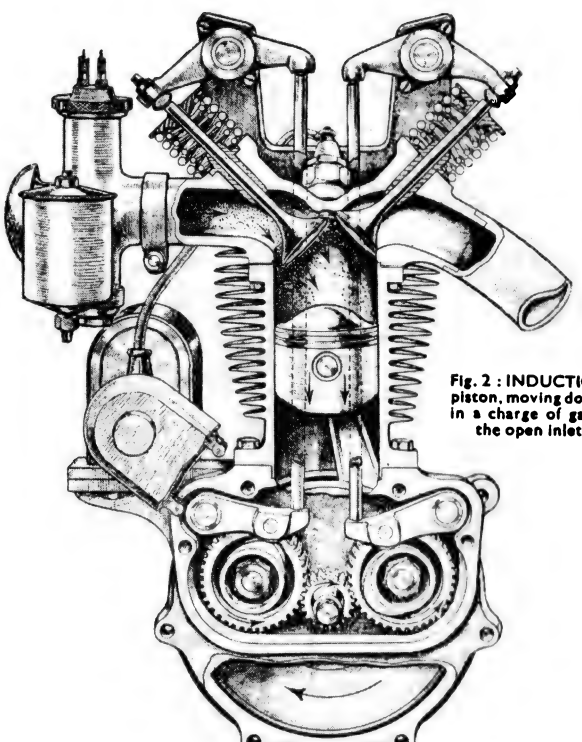


Fig. 2 : INDUCTION. The piston, moving down draws in a charge of gas through the open inlet valve

a two-stroke engine fires twice as frequently as a four-stroke, provided they are running at the same speed.

Let us consider the four-stroke engine first. The four strokes are known as the induction stroke (down), the compression stroke (up), the power stroke (down), and the exhaust stroke (up). The question that might be asked is, " How, since the engine has only one explosion every four strokes, does it manage to keep going ?" The answer is that attached to the crank are either one or two heavy wheels made of cast-iron or steel. As everyone

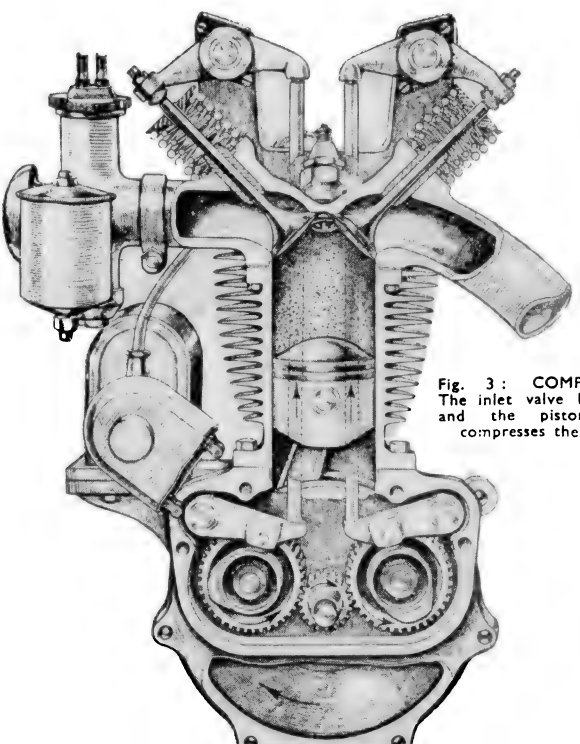


Fig. 3 : COMPRESSION. The inlet valve has closed and the piston, rising, compresses the charge

knows, it you give a wheel a push and start it revolving it will go on turning by virtue of the energy it has stored up from the impulse.

What happens, therefore, is that these heavy wheels attached to the crank store up sufficient energy from the explosion to continue rotating until the next explosion or power stroke occurs.

Now let us revert to the four-stroke. In an actual engine the cylinder is provided with two (occasionally four) mechanical doors known as valves, one connecting

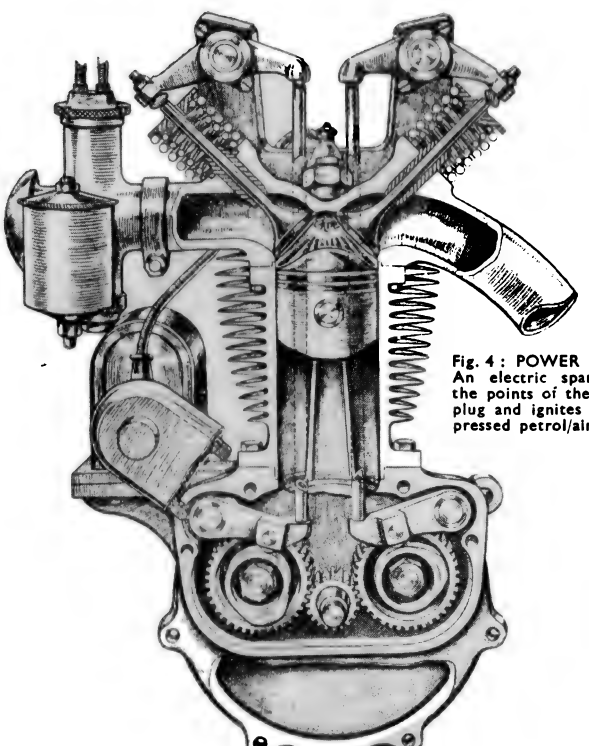


Fig. 4 : POWER STROKE. An electric spark jumps the points of the sparking plug and ignites the compressed petrol/air mixture

with the carburetter and the other with the outside air by way of the exhaust system.

On the engine being set in motion, by the rider pushing the machine or pressing down the kick-starter, the piston moves down on, say, the *induction stroke* ; at the same time the inlet valve, or door from the carburetter, is opened, and the piston " draws " a charge of petrol-air gas into the cylinder (Fig. 2). The inlet valve then closes, so that the cylinder becomes a gas-tight chamber, and the piston begins to rise on the *compression stroke* (Fig. 3).

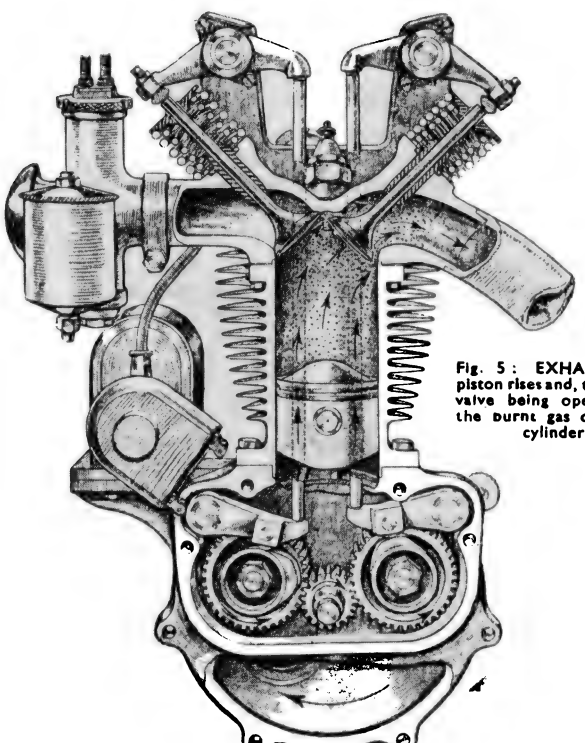


Fig. 5 : EXHAUST The piston rises and, the exhaust valve being open, pushes the burnt gas out of the cylinder

On the piston reaching the top an electric spark, automatically produced by the magneto, jumps across the points of the sparking plug and ignites the compressed gas (Fig. 4).

The rapid expansion of the burning gas—loosely speaking, the explosion—forces the piston down, giving it a mighty impulse ; this is the *power stroke*. Then follows the fourth stroke—the *exhaust stroke* (Fig. 5)—during which the piston rises and, the exhaust valve being open, pushes the burnt gas out of the cylinder. This completes the cycle of operations, which begins all over again.

In the illustrations the valves are mounted in the cylinder head, and for this reason the engine shown is said to be of the overhead-valve type. It will be seen that the valves are operated from pear-shaped devices, called cams, by means of rocking levers and push-rods. This is the arrangement whereby they are opened, while for closing purposes there are coil springs. Let us, however, leave further discussion of valves and valve gear to Chapter 2, and pass on to consider the two-stroke engine.

Unlike a four-stroke engine the two-stroke has neither inlet nor exhaust valves ; instead there are holes called " ports " cut in the cylinder which are covered and uncovered by the piston as it travels up and down. The usual number of ports is three : the inlet port, the transfer port and the exhaust port. The trio is indicated on page 8.

In this type of engine—the three-port two-stroke—the crank case plays an important part : not only does it act as the support for the crankshaft, but also, it will be seen, as a pumping chamber.

Figure 6 shows the start of the cycle of operations. The piston is rising, and in doing so causes a vacuum in the crank case, which is specially designed as an air-tight chamber. The piston is shown uncovering the inlet port. A mixture of petrol and air gas is rushing into the crank case from the carburetter—drawn in by the piston as it moves upwards. At the same time the upper side of the piston is compressing a charge of gas from the previous cycle of operations.

When the piston reaches the top of its stroke the charge in the combustion chamber is ignited by an electric spark.

THE TWO-STROKE CYCLE

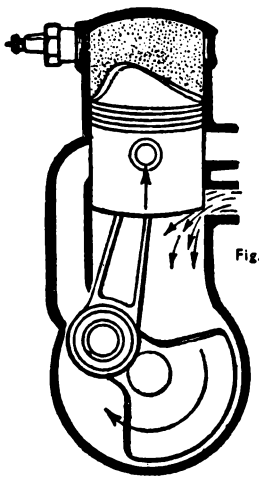


Fig. 6

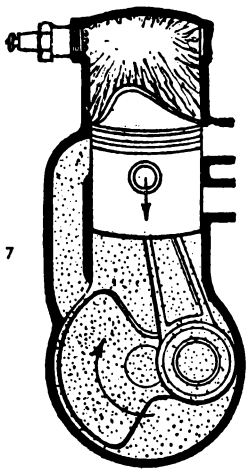


Fig. 7

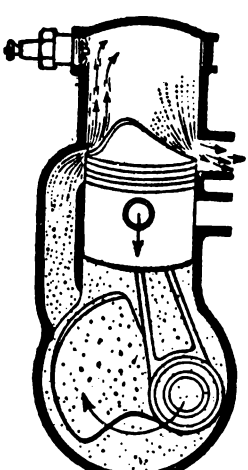


Fig. 8

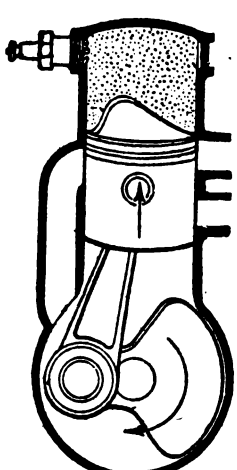
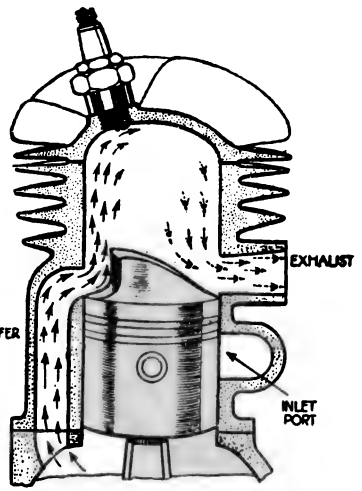


Fig. 9

Fig. 10 : The inlet, transfer and exhaust ports of a two-stroke engine



The explosion that results pushes down the piston, which now compresses the charge waiting in the crank case (Fig. 7). As the piston continues to travel down its stroke it uncovers the exhaust port, thus releasing the burnt gas, which passes through the port to the silencer and thence to the open air.

As it moves downward still farther the piston starts to uncover the transfer port, and the fresh charge of gas in the crank case is forced by the piston to travel up through the transfer port into the combustion chamber (Fig. 8). This "transfer" of the gas accomplished, the piston begins to rise and the whole cycle of operations begins again (Fig. 9).

The peculiar hump on top of the piston will have been noticed. This is the "deflector". Its object is to deflect the incoming fresh gas upward and keep it separate from the remains of the exhaust gas, which is still passing out of the cylinder via the exhaust port. Even were the exhausting process complete by the time the piston started to uncover the transfer port (which is not the case with this, the three-port type of engine) the deflector would be necessary to prevent the fresh gas from following the exhaust gas out of the cylinder and being wasted.

In these days there are many two-stroke engines which are so designed that the deflector-headed piston is unnecessary. This is accomplished by making the transfer port or ports do the needful deflecting by reason of their position and shape.

CHAPTER 2

ENGINE CONSTRUCTION

Typical Components : Side and Overhead Valves : Valve Timing : Two-Stroke Design

SO far we have considered engines mainly in diagrammatic form. Let us now pass on to an examination of the components of actual engines. Again a start will be made with a four-stroke engine. Figure 11 shows the flywheels and connecting rod of a typically modern single-cylinder engine. On the left the various parts are shown separately and on the right these same parts are assembled ready for fitting with other components to form a complete engine. The name of each part is given in order to make the construction perfectly clear.

It will be noticed that the connecting rod, which is forged from some of the strongest steel obtainable, is not of rectangular cross-section, but if cut across the middle would look like an I. The reason for this shape is that it affords strength and rigidity with the lowest possible weight. In the "small end" of the connecting rod is fitted a tubular-shaped piece of phosphor bronze.

This small-end "bush" is pressed into the connecting rod and forms the bearing surface for the gudgeon pin which is the means of joining the connecting rod to the piston and will be described when the time comes to discuss the piston. Holes are drilled in the little end of the connecting rod, and corresponding holes in the bush, so that oil may reach the gudgeon pin.

Similarly there is a pin—the crankpin—in the big end of the connecting rod. At one time it was customary for manufacturers to interpose between this crankpin and the big-end eye a phosphor-bronze bush, in which case the engine was said to have a plain big end. Nowadays, while a few manufacturers employ plain bearings

of one sort or another, the usual practice is to have a series of rollers. These are usually assembled in a cage made of Duralumin or some similar aluminium alloy. Thus we speak of an engine having a roller big-end bearing with two rows of caged rollers (Fig. 11 shows this arrangement).

The crankpin forms the link between the two flywheels. Usually this steel pin has shoulders which when the nuts at each end are screwed dead tight hold the flywheels

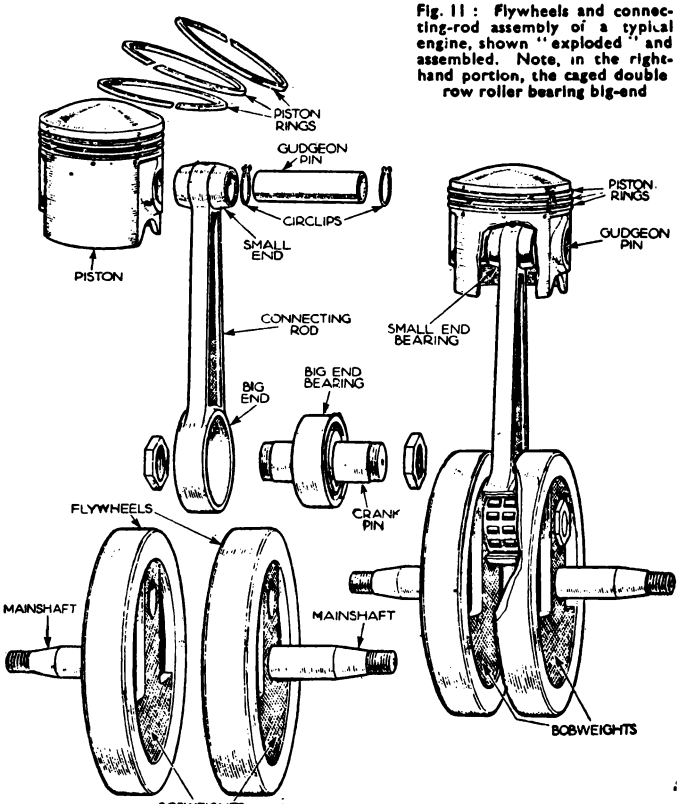


Fig. 11 : Flywheels and connecting-rod assembly of a typical engine, shown "exploded" and assembled. Note, in the right-hand portion, the caged double row roller bearing big-end

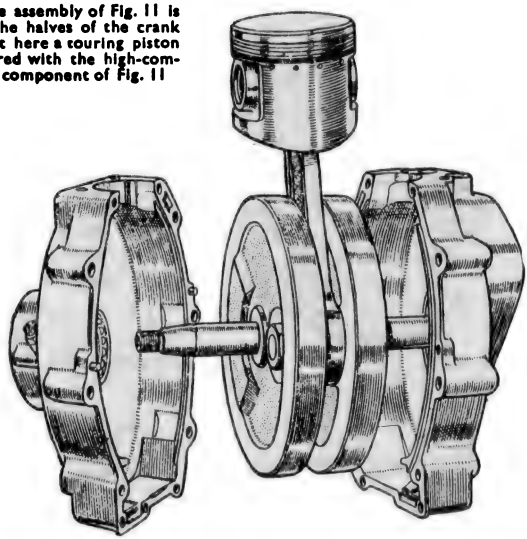
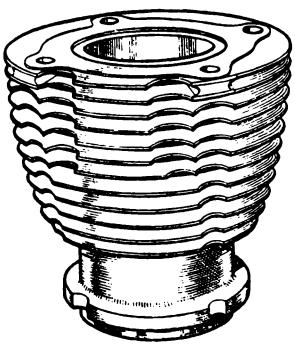


Fig. 12: How the assembly of Fig. 11 is mounted up in the halves of the crank case. Notice that here a touring piston is seen, as compared with the high-compression sports component of Fig. 11

rigidly together. In old-type engines it was usual to find that the ends of the crankpin were tapered to mate with holes of similar taper in the flywheels. This arrangement also applied to the engine shafts or spindles, fixed one in the centre of each flywheel. Now as a rule the shafts have a shoulder at the flywheel end.

This crankshaft assembly fits into the crank case (Fig. 12), which is usually in two halves and made of aluminium. On the left is seen the driving side of the crank case, and on the right the timing side, which in the complete engine will contain the cams, gear pinions and rocking levers for operating the valves—those "mechanical doors" we have mentioned earlier. An important point is that the crank case shall be as rigid as possible. Consequently many crank cases have strengthening ribs.

Bearings are interposed between the crank case and the driving- and timing-side shafts. On the driving side it is usual to have two or more rows of caged roller bearings. Similar bearings are often fitted on the timing side, but



sometimes a ball bearing or even a plain tube of phosphor-bronze (a phosphor-bronze bush) is employed.

For the moment we will leave the crank case with its timing gear, which may be of several different types, and pass on to the upper half of the engine. First there is the piston with its gudgeon pin and piston rings (Fig. 11). An aluminium alloy is the material used for pistons because it is light and is an exceptionally good conductor of heat.

Fig. 13 : A typical air-cooled cylinder barrel. Note the deep radiating fins

For the sake of lightness the gudgeon pin, which is of steel, is usually in the form of a tube. It is normally a push fit in the bosses of the piston and is prevented from moving endways in the piston by spring rings or " circlips" which are slipped into grooves cut inside the piston bosses. The little-end bush which, as already mentioned, is pressed into the connecting-rod, has an internal diameter such that it will just accommodate the gudgeon pin, permitting it to swivel freely but without any perceptible up-and-down play.

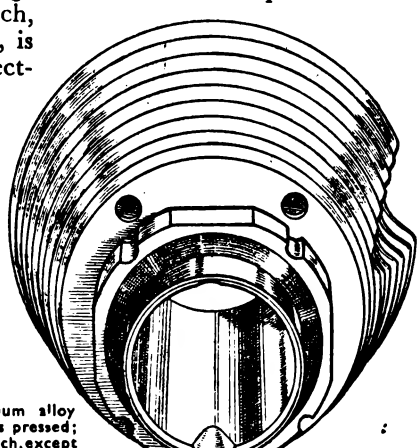


Fig. 14 : Here we have aluminium alloy finning into which a special liner is pressed; a flange " locates " the liner, which, except for this flange, is in the form of a tube

The function of the narrow cast-

iron rings that slip into the grooves of the piston is to make the cylinder gas-tight. They are made so that there is a certain amount of spring in them and, consequently, they press on the internal walls of the cylinder and seal the gap which results from the fact that, to allow for expansion, the piston has to be of smaller diameter than the internal bore of the cylinder.

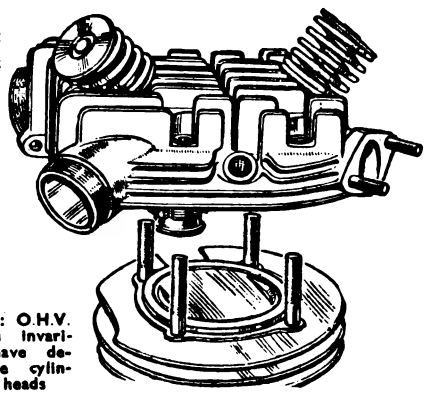


Fig. 15: O.H.V. engines invariably have detachable cylinder heads

The form taken by the cylinder depends, first, upon whether the engine is air or water-cooled. Where an engine is kept down to a suitable working temperature by the transfer of the heat of the cylinder direct to the air that passes over it, the cylinder is provided with deep fins. Usually some special form of cast iron is used for the cylinders.

Types of Cylinder Barrel

Figure 13 illustrates a typical air-cooled cylinder barrel. Occasionally, however—particularly in the case of racing engines—the fins are of aluminium alloy, while inside is a cast-iron or steel liner (Fig. 14) in the form of a tube. The inside of the cylinder—the cylinder bore it is called—has, of course, to be machined with great accuracy; any irregularities in the surface would tend to permit gas leakage and cause high frictional loss.

In these times it is the standard practice to have the cylinder head and cylinder barrel as separate components. Overhead-valve engines (Fig. 15) invariably have this arrangement, but old types of side-valve engine (Fig. 16) generally have the head and barrel cast in one.

Cylinder heads are usually made of cast iron, though occasionally, like cylinder barrels, those of overhead-valve engines are of composite construction. In this case the finning and exterior is often of aluminium, and the valve seats, and sometimes the whole internal dome, are of bronze. Occasionally the complete head is cast in aluminium-bronze. Figs. 17, 19 and 20 show different forms of overhead-valve cylinder head, while Fig. 18 illustrates a typical side-valve cylinder and cylinder head.

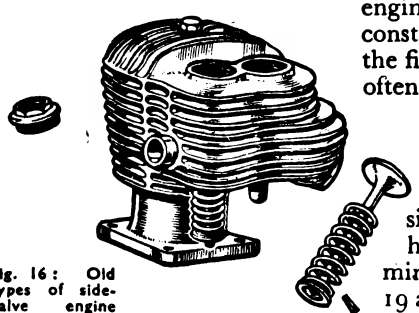


Fig. 16: Old types of side-valve engine generally have head and barrel cast in one

Where water is used as the cooling medium (actually it is only an intermediary since the radiator is, of course, cooled by air) there are no ribs on the cylinder and cylinder head, but water passages between the external and internal surfaces (Fig. 21).

The difference between a side-valve and an overhead-valve (o.h.v.) engine will have become apparent already. Let us for a minute consider how side valves are operated. Fig. 22 shows the timing gear and timing chest of a side-valve engine. In practice a cover, called the "timing cover" is, of course, fitted on the outside.

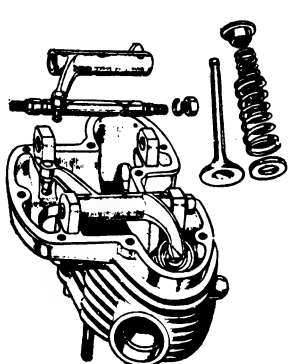


Fig. 17; O.H.V. cylinder head of the 250 c.c. Panther

The middle of the three gear pinions is the timing pinion, which is fixed to the end of the timing-side engine shaft.

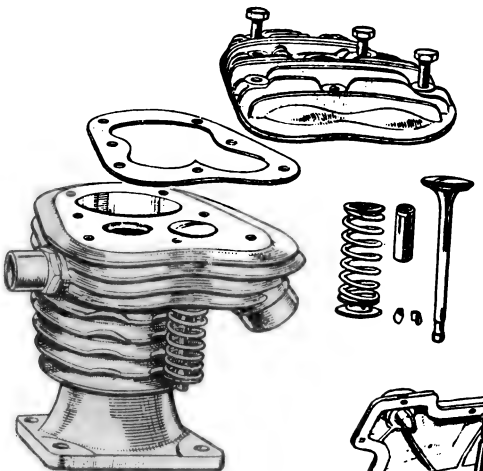


Fig. 18: A side-valve cylinder barrel and head, with a valve and its guide, spring, collar and collets

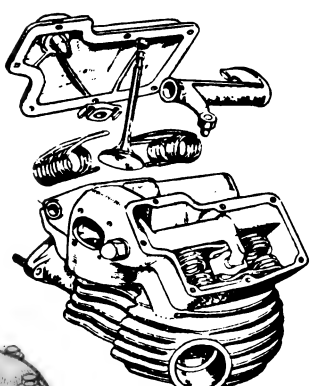


Fig. 19 (right): A B.S.A. design that employs hairpin springs for the overhead valves

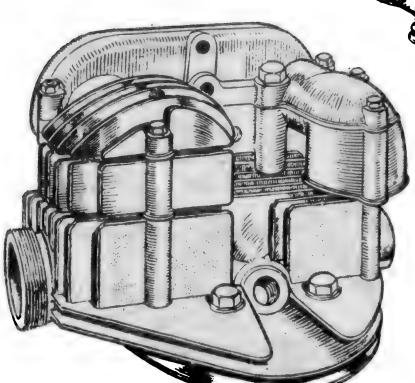


Fig. 20 (left): A J.A.P. cylinder-head arrangement

The other two pinions have double the number of teeth to be found on the timing pinion. Consequently they run at half its speed—that is, half the speed of the crankshaft—which is essential; if all three pinions were the same size each valve would open and close once each revolution, whereas, if you have fixed in your mind how a four-stroke engine works, you will know that they only open once every two revolutions of the crankshaft.

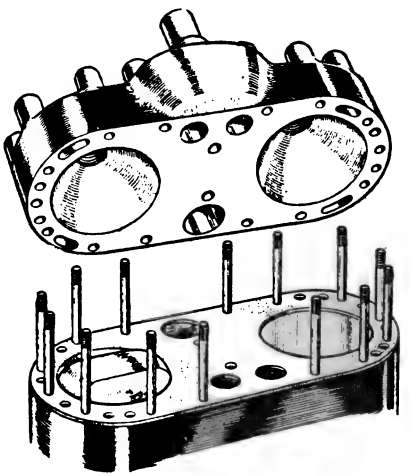
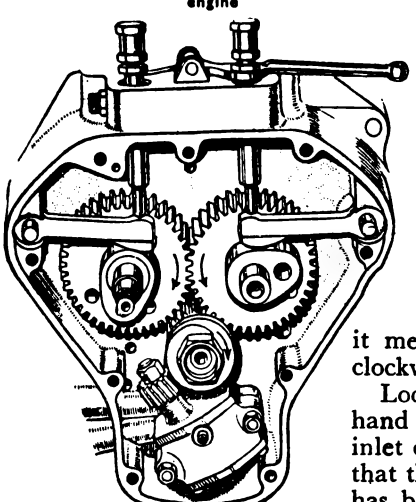


Fig. 21: Water-cooled engines have a jacket in place of external fins

Fig. 22: The timing gear and chest of a side-valve engine



The timing pinion turns in the same direction as the crankshaft; the usual direction is that shown by the arrow in the illustration. It is turning in a clockwise direction and therefore the pinion it meshes with turns anticlockwise.

Look closely at the left-hand pinion, which is the inlet cam pinion. Imagine that the exhaust cam pinion has been removed and you

are turning the inlet cam pinion round by hand. For a moment nothing particular would occur because the cam at this part is merely rounded; then the lump would start pushing up that little lever, the cam lever, forcing it upward and with it the tappet, which is the little rod immediately above, and the valve.

Continue turning and the point will be reached when the valve will start to close. The spring will cause the valve to close just as soon as the cam has been turned sufficiently. It is all very simple, though naturally the cam has to be shaped so that it opens the valve to an extent and for a period which experience proves to be best and the pinions have to be meshed so that the valve begins to open when the piston is in the correct position for opening.

"Timing the Valves"

We have only considered the inlet cam pinion, but everything applies equally to the exhaust cam pinion. Incidentally, meshing these pinions is referred to as "timing the valves". The spindles of the cams are mounted either in plain phosphor-bronze bushes or in ball bearings.

Sometimes instead of there being three pinions there are only two, the inlet and exhaust cams being fixed to the same pinion. Fig. 23 shows this arrangement. The actual operation of the valves is again by rocking levers, generally referred to as cam levers.

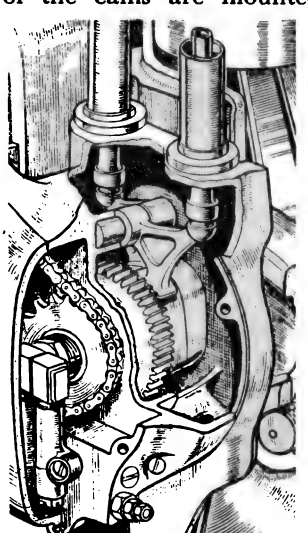


Fig. 23: In this engine the inlet and exhaust cams are fixed to the same pinion

Where an engine is of the overhead-valve type long rods, called push rods, are employed as intermediaries and there are rocking levers

mounted over the valves, Fig. 24 illustrates a simple type of overhead-valve gear. The method of operation is similar to that of the side-valve engine we have just considered.

Detail design varies considerably, of course. For instance, sometimes the timing gear is arranged so that the push rods are extremely short. In this case the cam pinion carries both the inlet and exhaust cams and is mounted above the timing pinion with two pinions provided just as intermediaries (Fig. 25). Engines such as

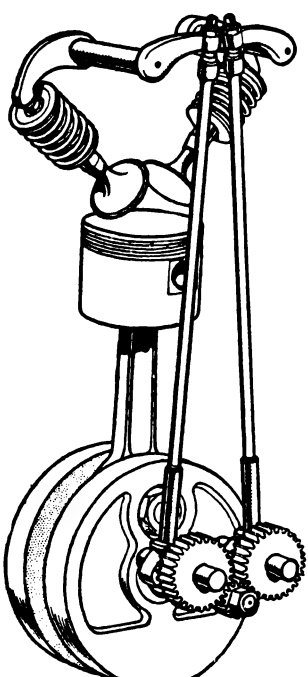


Fig. 24 : The essentials of simple push-rod operated o.h.v. gear

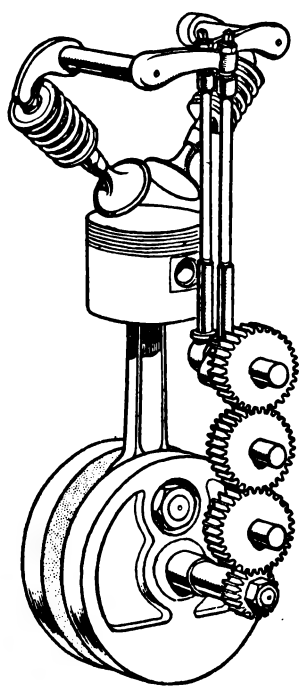


Fig. 25 : The "high-camshaft" type of engine ; one cam pinion carries both inlet and exhaust cams, and is mounted above the timing pinion with two driving pinions between them

this are referred to as being of the " high-camshaft " type and occasionally as having a " semi-overhead camshaft ".

There remains one other type of overhead-valve arrangement that has been adopted widely, namely, the overhead-camshaft. Strangely, the term " overhead-valve " is never applied to engines which have their cams above the cylinder head instead of in the timing chest. These engines are always referred to as " overhead camshafts " (o.h.c.), and the designation " o.h.v." is used solely for engines with the valves operated by push rods.

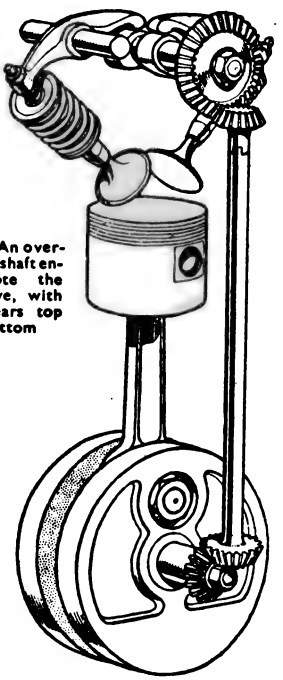


Fig. 26 : An overhead-camshaft engine: note the shaft drive, with bevel gears top and bottom

The usual practice in the case of overhead-camshaft engines is to have a vertical driving-shaft with bevel gears at the top and bottom. Fig. 26 shows the arrangement more clearly than any words. It will be noticed that the bevel fixed to the shaft that carries the cams is twice the size of the bevel that is driving it ; thus the camshaft runs at the necessary speed—half engine speed.

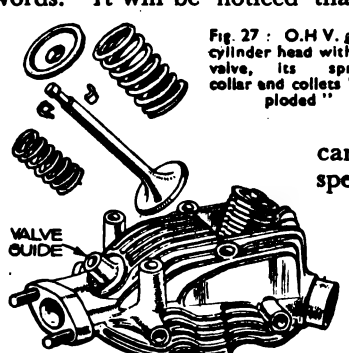


Fig. 27 : O.H V. gear ; cylinder head with one valve, its springs, collar and collets " exploded "

No doubt already a very fair idea has been gained of the shape of valves and valve ports and the way the valves open and close. Fig. 27 shows an overhead-valve

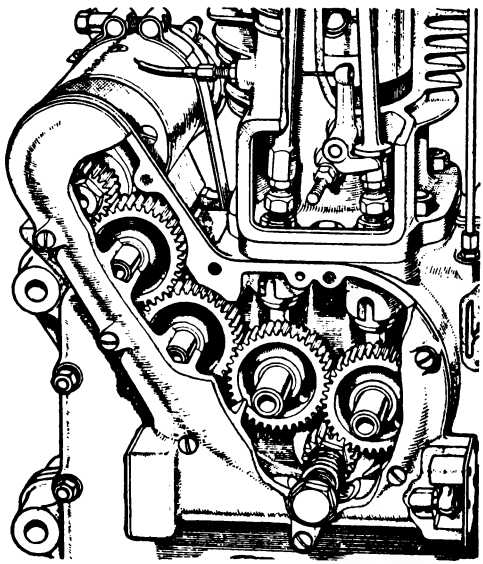


Fig. 28 : Magneto drive in a four-stroke engine taken via a train of gears from the inlet cam pinion

cylinder head, with one valve and its springs, collars and collets "exploded".

It will be noticed that the stems of the valves do not run directly in the metal of the cylinder head, but in detachable tubular housings, termed valve guides. These valve guides are usually of cast-iron, phosphor-bronze or cast-iron with a phosphor-bronze liner or bush and are made detachable so that when wear takes place they can be replaced at low cost—shillings as against pounds for a new cylinder head. In these days the valve guides are usually provided with some form of automatic lubrication.

A close look at the valve head—the mushroom-shaped head—shows that it has a tapered seat on its face. This presses on a similar seat in the cylinder head and is the means adopted to make the valve gastight. In British practice the valve face and the valve seat in the cylinder head are cut at an angle of 45 degrees ; the two surfaces are cut with great accuracy by machine tools, but this is not enough to make the valve absolutely gastight—it must be mated to the seat by grinding them together with an emery-like abrasive mixed with oil ; this is called

grinding-in paste and the work of grinding-in the valve is usually accomplished by hand, as is described later.

The timing gear, in addition to operating the valves, is responsible for ensuring that the spark occurs in the cylinder at the " right time "—that is, when the piston is on the correct stroke and in the most suitable position. Various means are employed for generating the electricity for the spark, as will be seen in Chapter 7. The magneto on four-stroke engines is usually driven from the timing gear by gears off either the inlet or exhaust cam pinion (Fig. 28 shows the drive being taken from the inlet cam pinion) or by means of a cycle type chain and small chain wheels called sprockets (Fig. 29 illustrates a drive taken from the inlet cam spindle, the driving sprocket being mounted directly upon the cam spindle).

Where there is a chain drive of this type, the chain is enclosed within what is termed the magneto chain case, as shown in the illustration. Occasionally the drive is taken by chain direct from a sprocket on the crankshaft to one double its size on the magneto. This difference in size is necessary because the magneto has to run at half engine speed, i.e., provide a spark once every two revolutions of the engine.

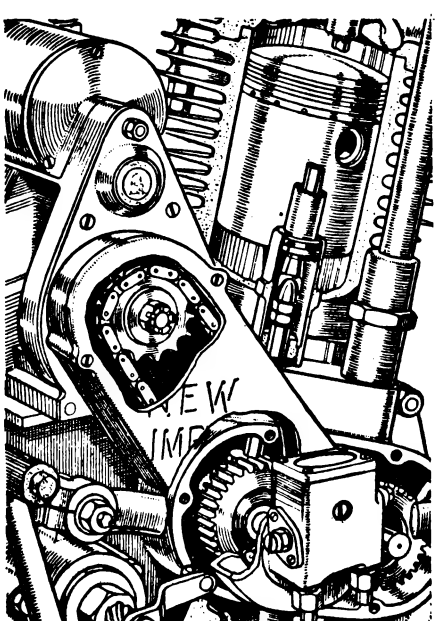


Fig. 29 : A chain-driven magneto ; in this case a driving sprocket is mounted directly on the inlet cam spindle

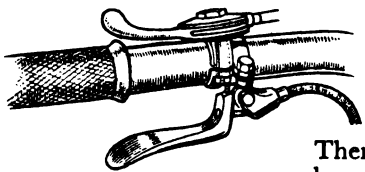
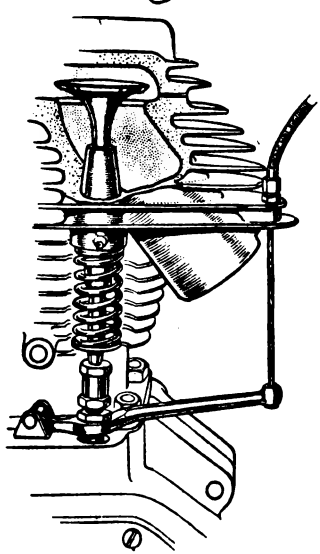


Fig. 30 : A simple form of exhaust valve lifter mechanism, complete with handlebar control



There is an exception to this rule : one instrument, which combines the functions of spark-producer and generator of electrical current for the lights, runs at engine speed, but since the spark is there to no purpose—it is an " idle spark " at the top of the exhaust stroke —we need not bother our heads about it at this juncture.

Generally the exhaust valve mechanism is provided with a means whereby the valve can be held in the open position by operation of a control lever on the handlebars. Fig. 30 shows a simple form of exhaust-valve lifter mechanism complete with its handlebar control. It will be noticed that pulling the lever on the handlebars in the direction of the bars operates the lever on the timing chest and this, in turn, raises the valve. Actual design varies considerably ; sometimes a little cam is employed instead of the lever shown on the timing chest.

A few big single-cylinder engines are fitted with what is termed a decompressor. This is to facilitate starting. As its name implies its function is to reduce the compression in the cylinder, thus making it easier for the rider to overcome the resistance of the cylinder compression when kick-starting. It generally takes the form of a special cam which is brought into operation by means of a lever on the crank case and is used only for starting purposes.

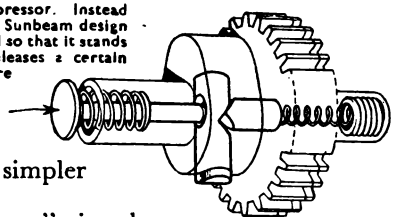


Fig. 31: A simple type of decompressor. Instead of there being a second cam, in this Sunbeam design there is a plunger that can be moved so that it stands proud of the exhaust cam and releases a certain amount of cylinder pressure

Fig. 31 shows one of the simpler designs.

A "compression release" is also employed in many two-stroke engines. In this type of unit it takes the form of a special little mushroom valve, which serves no purpose other than those of reducing the compression to facilitate starting and adding to the braking power of the machine. This latter use is entirely subsidiary—the advantage that accrues on the descent of steep hills is accidental rather than deliberate. What happens is this: by raising the release valve a trifle the rider, assuming that the throttle is closed, causes the engine to act as an extremely inefficient form of pump and thus provide smooth, yet quite effective, braking on the rear wheel.

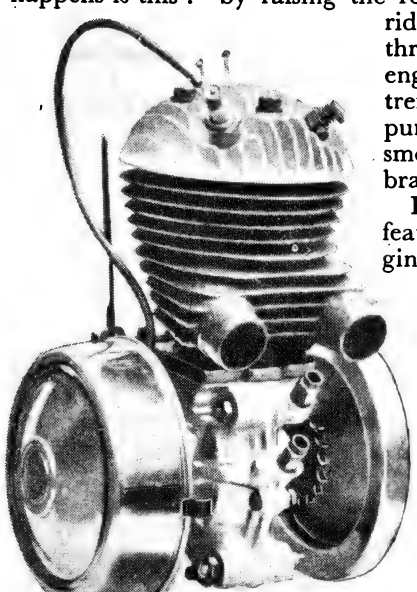


Fig. 32: In many two strokes the magneto is mounted directly on the end of the crankshaft and is incorporated with an outside flywheel. Note the aluminium-alloy cylinder head

In its constructional features the two-stroke engine is very similar to the four-stroke. The crank case is of more simple formation since there is no timing gear to house. In some engines provision is made within an extension of

the crank case for driving a magneto by a chain and sprockets.

In this case, since a two-stroke has to fire once each revolution, the driving sprocket is mounted on the crankshaft and is connected by the chain to a sprocket of equal size fixed to the magneto. More frequently, however, the magneto is mounted directly on the end of the crankshaft and is incorporated with an outside flywheel (Fig. 32).

"Coil ignition", which is described in detail in Chapter 7, is often used on both two-stroke and four-stroke engines. The actual timing device—the contact breaker or distributor—is usually driven in one of the ways that have been mentioned.

Next to the fact that it has no timing chest the major difference between the crank case of a two-stroke and that of a four-stroke is that the former has to be designed so that it forms a gastight chamber. The crankshaft bearings must allow no leakage along the shafts. Because of this it is quite usual to find that the main bearings take the form of long phosphor-bronze bushes.

If ball or roller bearings are employed there are usually felt or other packing washers to act as gas seals.

The Two-Stroke

The cylinder of a two-stroke differs from that of a four-stroke in that it has ports in its walls—there are no valves to be incorporated in either the cylinder or cylinder head other than the small compression-release valve that has been mentioned a little earlier. Because of this the cylinder head, which may be either combined with the cylinder as one casting or a separate entity bolted on, is of very simple construction. When of the bolted-on type the cylinder head often takes the form of an aluminium-alloy casting, as in Fig. 32.

Naturally the joint between the cylinder and cylinder head must be gastight. This, of course, also applies to the cylinder-head joints of four-stroke engines. Sometimes a ground joint is employed, the surface on the cylinder head and that on the cylinder being ground-in—one

on the other—with abrasive until the two mate perfectly. Often, however, a soft packing is interposed between the two surfaces. This is generally called a " gasket " and may be of soft copper, aluminium, copper and asbestos or even some form of asbestos sheeting.

For four-stroke engines the usual material for pistons, it was mentioned, is an aluminium alloy. Similar material is frequently employed for two-stroke pistons, but where long wearing qualities are more important than a particularly high engine performance the metal used is often cast-iron.

" Pegged " Piston Rings

One important difference between the piston of a two-stroke engine and that of a four-stroke is that whereas the piston ring grooves in the latter case are merely plain slots, a two-stroke piston has in each slot a little device called a " peg " which prevents the piston rings moving round the piston. Fig. 33 shows one of these so-called " pegs ". If it were not for these, the rings might slip round in their grooves until the ends of one or other of them were opposite one of the ports. Were this to happen the ends of the ring, springing outwards into the port, would almost certainly become caught, and the result be that the engine was seriously damaged.

This covers the main constructional features of the normal types of two-stroke and four-stroke engines, so now we will pass on to consider the relative advantages and disadvantages of the engines in current use.

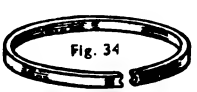


Fig. 33 : The piston grooves of a two-stroke are fitted with pegs to stop the rings turning round and becoming jammed in the ports ; and the rings (Fig. 34) have shaped ends to fit the pegs

CHAPTER 3

TYPES OF POWER UNIT

Single-, Twin-, and Multi-Cylinder Units

MANY types of motor cycle engine have been produced. There are single-cylinder four-strokes with side valves, with push-rod-operated overhead valves, with high camshafts (and short push rods) and with overhead camshafts. There are two-strokes with a single cylinder, with twin cylinders and three cylinders ; four stroke engines, both with side and overhead valves, that have two cylinders set in the form of a " V ", or opposite each other, or alongside one another.

There are four-cylinder four-strokes with the cylinders set in a straight line, vertically in the form of a square, horizontally with one pair opposite to the other and arranged in the form of a " V ". The possible types are almost legion, but before discussing the advantages and disadvantages of the various arrangements in common use, let us consider briefly the relative merits of two-stroke and four-stroke.

The outstanding feature of the three-port two-stroke and the more recent development, the two-stroke with a flat-topped piston, is simplicity. There are only three moving parts : the piston, the connecting rod and the crankshaft. Because of this it is a type of engine that makes an especial appeal to the novice and to those who feel they have no " mechanical bent ".

Another big advantage is its smooth flow of power under load ; compared with a four-stroke of the same number of cylinders the two-stroke engine, for a given gear ratio, fires twice as frequently.

It does not require the same amount of attention—there are no tappets to adjust and, except for the compression release, which is not touched from one year's end to the next, there are no valves to be ground in and thus maintained gastight. On the other hand, the piston rings in some two-stroke engines have a tendency to gum up in their grooves ; when this occurs they have to be freed or replaced with new ones in order that the engine may continue to give of its best. In addition, many two-stroke engines are liable to run irregularly at low engine speeds, unless they are pulling as, for example, up a gradient.

Size for size, the two-stroke is seldom quite so economical as the equivalent four-stroke, and seldom develops so much power as the four-stroke of the overhead-valve type. Its greatest features are its smooth flow of power under normal riding conditions—its smooth " torque ", in other words—its simplicity, the fact that it is a warrior for hard work and the easy way it hums along.

The Side-Valve Four-Stroke

Power for power, the side-valve four-stroke is much on a par with the touring two-stroke engine. With certain exceptions the side-valve engine is specifically designed for touring, as opposed to sports purposes ; in the bigger sizes it has a great name for its slogging power. It is the simplest type of four-stroke engine, and the easiest as regards decarbonisation and carrying out routine adjustments. For the man who has no interest in " tinkering ", and wants an engine that will require next to no replacements, the side-valve stands out as *the* type of four-stroke.

Fashion, however, decrees that overhead-valve and overhead-camshaft engines are far and away more popular. These types are definitely more efficient in power output, and generally they will cover a slightly greater mileage on a gallon of fuel, assuming that the speed and road conditions are the same. But they have more parts and more wearing surfaces ; consequently they require more frequent adjustment and replacement of parts.

Of the push-rod and overhead-camshaft engines the latter has the advantage that there are no push rods—periodical replacements are likely to be fewer. The high-camshaft (or "semi-overhead camshaft") engine may be said to come roughly mid-way between these two types, since the push rods are short and light.

In sheer power output and in fuel economy there is little to choose between these three types. The overhead-camshaft engine, with its bevel gears, is generally the most expensive and, in the opinion of many, the finest mechanical job.

From this arises the question, "Why are the overhead-valve and overhead-camshaft engines more powerful and economical than the side-valve?" The primary reason is that by fitting the valves in the top of the cylinder head instead of at the side the designer is able to provide a more compact and efficient cylinder head. Greater use can be made of the heat generated in each explosion and also the petrol and air is burned more efficiently. On the other hand routine maintenance is not so easy.

Where the "Multi" Scores

That, very briefly, sketches the relative advantages. So far, however, although the fact has not been stressed, only single-cylinder engines have been in mind. This type of engine, whether two-stroke or four-stroke, is difficult to silence as regards the exhaust, unless the particular unit is of low efficiency or there is no serious objection to the silencing system detracting fairly considerably from the power output. This is the big objection to the "single"; also the four-stroke single—particularly if large and of the high-efficiency o.h.v. or o.h.c. type—is liable to be difficult to start in unskilled hands and to be intractable in traffic. These form the price paid for the single's simplicity and the motor-cycling public's demand for a high output from a given size of engine.

For these reasons there is a steadily increasing interest in multi-cylinder engines—power units with two or more cylinders. With a "multi" it is possible to obtain far

smoother running, easier starting and real silence, and yet retain the power of the high-efficiency single.

In addition, the multi, with its smooth flow of power and its "responsiveness", provides exceptional acceleration. It is a docile type of engine, but, of course, lacks the simplicity of the single when it comes to the need for an overhaul. In actual practice decarbonisation is not required nearly so frequently, and the various parts, owing to their lightness and the smooth flow of power, normally wear more slowly.

The majority of those who have the opportunity of riding all types of motor cycle maintain that this, the multi-cylinder, is the power unit that gives motor cycling at its best. Inevitably, however, being a more complicated engine it is not so cheap to make as a single-cylinder and, therefore, multi-cylinder machines are the more expensive.

Fuel Consumption

In the matter of fuel consumption there is little in it. The "multi" is generally not quite so economical; this is so in theory, and in practice those who own multi-cylinder machines often ride rather harder than when handling "singles"—they can do so because of the smooth, controllable power and silence.

One objection to the "single" that is often raised by those with little knowledge of motor cycles is that it vibrates. To-day this is largely a myth. It is true that it is impossible to balance a single-cylinder engine perfectly, but designers have succeeded in balancing single-cylinder engines so that there is no appreciable period of vibration throughout the speed range that any ordinary rider will use. There are exceptions to this rule, but practically no modern "single" will ever give its rider "pins and needles"—a complaint by no means unknown in the "bad old days." It is assumed that the bolts fixing the crankcase to the frame are tight—otherwise there *will* be serious vibration!

In the illustrations (Figs. 35 to 37) are shown various normal types of multi-cylinder engine in diagrammatic form. Figure 35 is that of the flat-twin or horizontally-opposed twin-cylinder engine. This is one of the simplest

Fig. 35 : Diagrammatic illustration of the crankshaft arrangement of the "flat-twin" or horizontally - opposed twin-cylinder engine

types of multi-cylinder. Sometimes the cylinders are arranged along the frame of the machine, sometimes across it. In the latter case the engine is referred to as a "transverse flat-twin." The advantage of this latter arrangement is that both cylinders receive a direct air blast and consequently are excellently cooled. Against this must be set the fact that the cylinders extend sideways instead of being contained within the frame, as with the flat-twin with the cylinders arranged in line with the wheels of the machine.

From the point of view of smoothness and freedom from vibration this type of engine is excellent. The firing strokes are evenly spaced. When one cylinder is on the induction stroke, the other is on the power stroke. It will be noticed that the pistons move inwards and outwards together. Were the cylinders and pistons exactly opposite each other this type of engine would be perfectly balanced. The arrangement of the crankshaft, however, demands that the cylinders, pistons and cranks shall be slightly offset. This means that there is a slight twisting movement on the crankshaft—one piston is not pushing and pulling against the other, but a little to one side and, therefore, endeavouring to set up a rocking motion. This "couple", as it is called, prevents perfect balance—which does not mean that the balance is *im*perfect; actually the engine is very smooth indeed.

Next is another type of twin-cylinder engine (Fig. 36). Here the cylinders are set vertically and the pistons move up and down

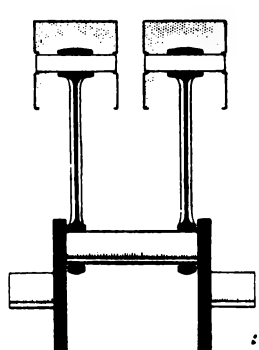


Fig. 36 : A twin-cylinder design with vertical cylinders and the pistons "in step"

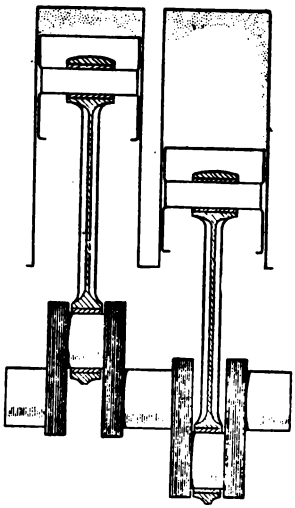


Fig. 37. The same type as in Fig. 36, but with opposed cranks

together. In effect this engine is equivalent to two "singles". The balance is the same, but the engine is, of course, much smoother because for every two revolutions of the crankshaft there are two firing strokes instead of only one. Usually this type of engine is arranged with the crankshaft set across the frame of the machine; thus the cylinders are both excellently cooled.

Fig. 37 shows a somewhat similar type of twin, but in this case the cranks are set opposite each other. The pistons do not move together, but one goes up as the other descends.

The balance in this case is better than with the twin shown in Fig. 36. The motion of the pistons is opposed; nevertheless the balance is not so good as that of the flat-twin. For one thing the connecting rods have to be set farther apart, and there is, therefore, a larger rocking couple; again, one piston is at the bottom of its stroke when the other is at the top—except at the middle of the stroke the pistons are always at different distances from the axis of the crankshaft.

The vee-twin engine has been the most popular type of motor cycle power unit next to the single-cylinder. The reason for its popularity as compared with, say, the flat-twin is that it is easy to house in a motor cycle frame of the conventional type. Its balance is better than that of the single, but not so good as the flat-twin. Usually the cylinders are set at a comparatively small angle. Actually the more nearly the angle between the cylinders approaches 90 degrees the better becomes the

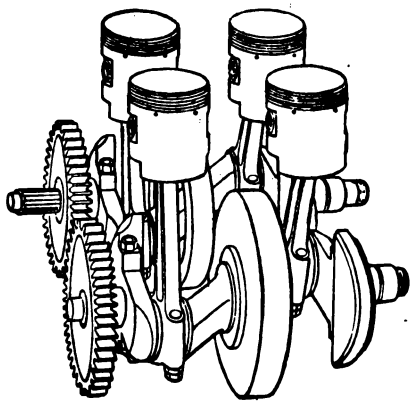


Fig. 38 · The essentials of the Ariel "Square Four" type of engine

balance, but a wide angle engine cannot be housed easily.

From the twin, let us pass on to the four. The simplest type is the four-cylinder-in-line engine. This is, of course, the type used in hundreds of thousands of cars, but, to date, it has not achieved great popularity in the motor cycle world because of its overall length and consequently the difficulty of accommodating in a compact machine. In addition, unless the engine is set across the frame it is difficult to ensure that each of the cylinders of an air-cooled four-in-line is adequately cooled.

Water-cooling enables this form of engine to be more compact and overcomes the cooling difficulty. In the opinion of many skilled technical men, the water-cooled four has a big future.

The word "perfect" cannot be used to describe the balance of the four-in-line engine, but the engine as a whole is in what is termed "primary balance". In

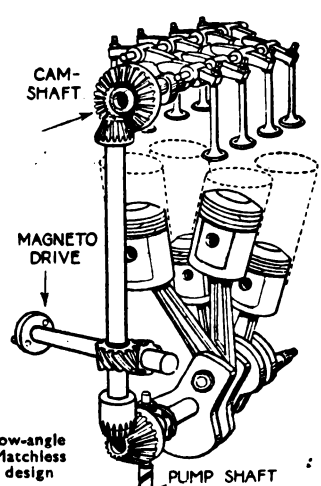


Fig. 39: A narrow-angle vee-four—the Matchless "Silver Hawk" design

effect, this type of engine consists of two side-by-side twins of the type shown in Fig. 37.

The twin, as has been mentioned, has a rocking couple, the extent of which depends upon the distance between the connecting rods. In the case of the four-in-line engine there are naturally two couples, but these, instead of aggravating each other, are opposed and, so far as the

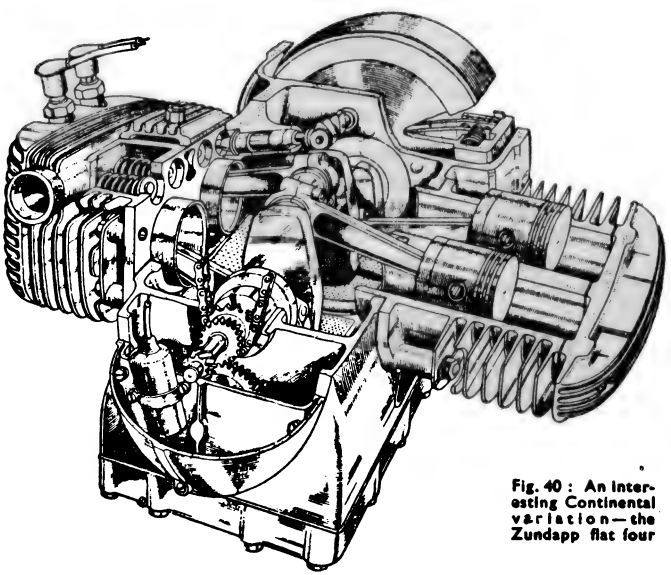


Fig. 40 : An interesting Continental variation—the Zundapp flat four

whole engine is concerned, cancel each other out. The result, assuming good design, is a power unit that is outstandingly smooth in operation.

A more compact type of engine—probably the most compact form of four-cylinderthat can possibly be devised—is the square four (Fig. 38). Here you have all the smooth, even flow of power of the four-in-line engine and equally good balance. Other types of four are the narrow-angle vee (Fig. 39) and the flat four, which is equivalent to two flat twins laid side by side (Fig. 40).

CHAPTER 4

CARBURATION

How the Carburetter Works : Typical Instruments

A CARBURETTER consists of four essential parts : float chamber, mixing chamber, jet and throttle. This last is, in effect, a tap and controls the amount of " gas " that is allowed to enter the cylinder. The drawing (Fig. 41) shows the fuel system of a motor cycle in diagrammatic form. Petrol flows from the tank to the carburetter by gravity by way of a copper pipe and tap. It enters the float chamber, which may be of either the top- or bottom-feed type. In the drawing a bottom feed is shown—that is, the petrol pipe is fixed to the underside of the float chamber and not to the top.

In shape the float chamber is very much after the style of a small-sized cocoa tin. It contains a brass buoy—called a float—which carries a needle with a cone-shaped end. As petrol enters the float chamber from the tank it causes the float to rise. Since the float carries the needle, the point is eventually reached when the little cone on the needle comes up against a seat and automatically cuts off the petrol supply. Obviously as the engine uses petrol and the petrol level in the float chamber falls, the float and its needle also fall, thus letting in additional fuel. This simple mechanism, therefore, ensures that the level in the float chamber is maintained at a certain definite height, which is set by the makers of the particular carburetter.

Connected with the float chamber in Fig. 41 is a little pipe which carries at the top a small screwed stopper. This stopper has a minute hole in it and is called the " jet ".

No petrol can enter the engine without passing through this jet. The larger the jet the more petrol can flow through it in a given period of time. This is obvious, but important, because of the effect upon the mixture strength. As will be seen later, if we want to make the mixture richer—in other words, have a larger proportion of petrol in the petrol-air mixture—we fit a larger jet.

The standard arrangement is that the petrol in the float chamber is maintained at a slightly lower level than that of the top of the jet (or jet tube); thus it requires definite suction from the engine to draw petrol from the carburetter—petrol cannot overflow of its own accord unless the machine is leaning over at a big angle.

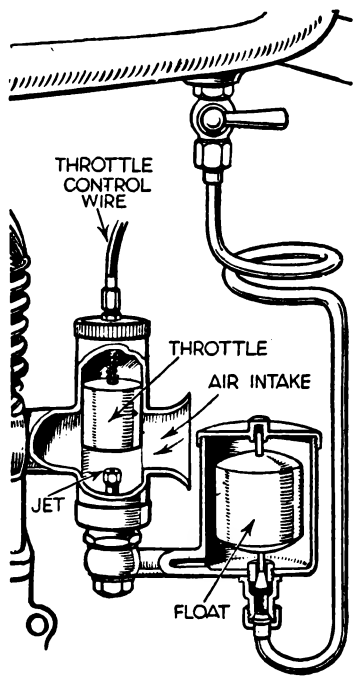


Fig. 41 : The essentials of the fuel supply. An anti-vibration coil is set in the copper petrol pipe to prevent breakage

As the piston in a four-stroke engine descends on the induction stroke, it causes air from the air intake of the carburetter to rush along the pipe, past the throttle and into the combustion chamber. In passing over the jet the air pulls petrol from the jet in the same way as a scent spray operates or a sprayer of the type used to disinfect a room or kill flies. On the internal shape of the pipe depends the speed at which the air travels over the jet, and this and the size of the jet determine how much petrol the air picks up on its way into the engine—in other words, the strength of the petrol-air mixture.

Referring again to Fig. 41 it will be seen that the lower the cylindrical block of brass—the throttle—is, the less petrol-air can reach the engine, and vice versa. The throttle is connected by a cable to a lever or twist-grip on the handlebar. This, in effect, is the speed control. The more the lever is opened or the twist-grip turned towards the open position, the higher the throttle is raised in the mixing chamber and the larger the quantity of mixture the engine induces.

Typical Modern Carburetters

While the foregoing discussion has applied to a carburetter in diagrammatic form, in actual practice motor cycle carburetters are not very different from the simple instrument that has been postulated. Let us consider a few typical modern instruments—first, the type of Amal that is fitted to large numbers of small motor cycle engines. This is shown partly dismantled (Fig. 42). In this case the float chamber has a top feed, and consequently the float needle tapers to a point at the top instead of having a cone-shaped seat at the bottom. The throttle slide in the mixing chamber will be seen, also the controlling lever for mounting on the handlebar. The spring that will be noticed between the throttle slide and the screwed-on cap at the top of the mixing chamber is merely a return spring—necessary in order that the throttle automatically closes when the handlebar lever is moved to the closed position.

The little flap attached to the air intake is only to facilitate starting the engine from cold. When it is swivelled in an upwards direction it closes the air intake, except for a small hole. (This hole, it will be noticed, is in the cap itself.) Once the engine has started, and the rich mixture that this obstruction to the air supply causes is no longer required, the flap is swivelled out of the way.

Level with the bottom of the air intake is the jet block, which carries the jets. In this case there are two jets, and not merely one, as was the case in the simple diagram we have been considering earlier. The long jet, nearer the air intake, is the " main " jet. The other one, which

does not protrude above the jet block, is the " pilot " jet ; its function is to control the strength of the mixture at small throttle openings. As the throttle opening is increased the main jet comes into operation.

Fig. 43 shows a larger type of Amal carburetter. In its method of operation this instrument is similar to all Amal carburetters fitted to touring machines other than those of very small engine size. In this case a bottom-feed float chamber is shown ; for some machines a top-feed is employed. In addition the mixing chamber is vertical, whereas, in the case of certain motor cycles the mixing chamber has to be horizontal because of lack of room between the inlet port and the fuel tank.

The float chamber needs little description. It operates in exactly the same way as that of our "diagrammatic instrument", but there are one or two points of interest. First, there is the method by which the needle is attached to the float. At the top of the float, and fixed to it, there is a bow-shaped spring which clips into a groove cut in the needle (Fig. 43.) Pressing the ends of the bow lightly together enables the needle to be either removed or replaced.

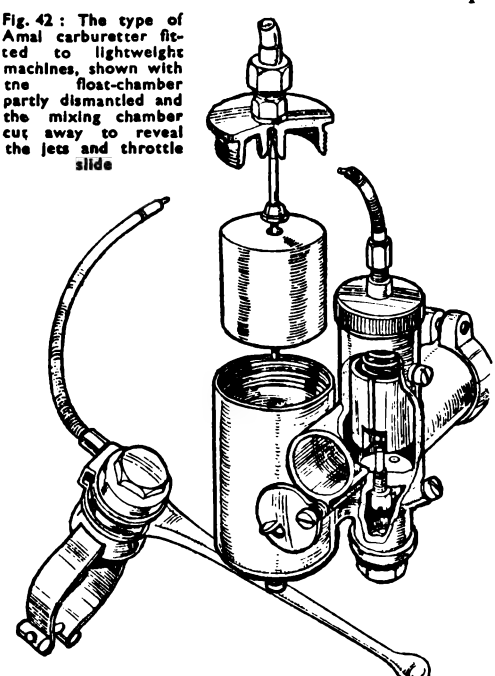


Fig. 42 : The type of Amal carburetter fitted to lightweight machines, shown with the float-chamber partly dismantled and the mixing chamber cut away to reveal the jets and throttle slide

It will be noticed that there are three protruding portions on the lid of the float chamber. The hexagon-headed stud on the right is a locking device to prevent the lid working loose ; it must be slackened off previous to the lid being unscrewed. The hexagon to be found in the middle is merely to facilitate unscrewing the lid.

The device on the left is what is termed the " tickler ".

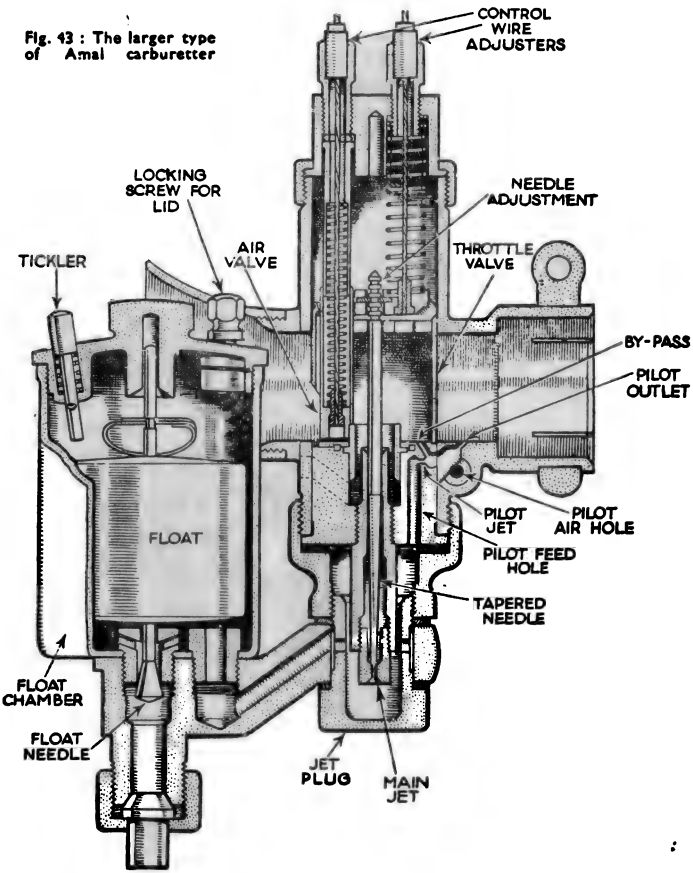


Fig. 43 : The larger type of Amal carburetter

Pressing down the little protruding plunger depresses the float, thus allowing additional petrol to flow into the float chamber. This is only used previous to the engine being started from cold. By depressing the tickler one enrichens the mixture. This is called " flooding the carburetter ", and the plan is to press down the tickler until petrol starts to ooze from the bottom of the mixing chamber. As a rule it is inadvisable to flood the carburetter to excess, particularly in the case of a two-stroke engine, and normally the carburetter should not be flooded if the engine is warm.

The mixing chamber portion of the carburetter is not complicated, although the sectional drawing may make it seem so to the uninitiated. Starting at the bottom, there is first the screwed hexagon plug which fixes the float chamber to the mixing chamber. Immediately above is the main jet, which controls the mixture strength at large throttle openings. This screws into a form of tube, in which will be seen a long tapered needle. The needle is fixed to the throttle slide by means of a spring clip.

How the Throttle Works

As the throttle is raised, so the tapered needle rises and because of the taper, there is more space between the needle and the tube—hence there is less obstruction to the flow of petrol. When the throttle is fully open, the needle is well up and the important factor is the size of the main jet. The larger this is, the richer the mixture is at large throttle openings. At intermediate throttle openings the controlling factor is the needle, which has several grooves at the top to enable the user to alter the amount by which the needle protrudes from the throttle slide. The more the needle extends below the slide, the weaker the mixture at intermediate throttle openings and vice versa.

The question that remains is the control of the mixture at very small throttle openings—that is when the throttle is nearly shut and the engine inducing only a whiff of mixture. For this there is a special slow-running device—the pilot jet. On the right of the needle, about a third the way up the mixing chamber, will be seen a vertical passage

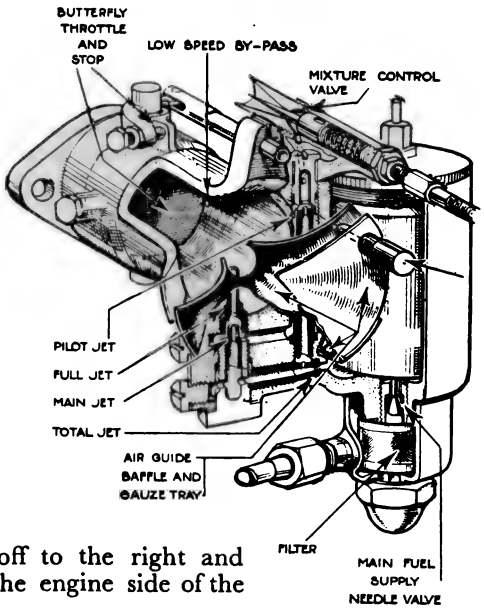


Fig. 44 : A Bowden carburetter in part section. A "butterfly" or hinged-flap throttle is used, and two of the jets are submerged

that branches off to the right and comes out on the engine side of the throttle slide.

This is the pilot-jet passage and the little circle alongside the black shading near the top of the passage is the adjusting screw ; it protrudes horizontally from the mixing chamber and can be altered by the rider to suit his particular engine. A screw to be found set at an angle in the side of the mixing chamber is a throttle stop and enables the rider to set the throttle so that, if he so desires, it does not close completely when the handlebar control is shut.

Finally, it will be noticed that there are two cables running into the top of the mixing chamber. That on the right is the cable operating the throttle slide, while the one on the left controls the small slide that will be seen immediately beneath. This is the air slide. It does not close down the air intake to anything like the same extent as the flap on the Type 53 Amal carburetter and only affects the mixture strength between fairly narrow limits.

Usually it is closed for starting, and then opened to the maximum extent and left there. For all normal running the carburetter is completely automatic, and the rider controls the machine on the throttle, leaving the air lever alone.

Fig. 44 shows a Bowden carburetter in part section. The float chamber arrangement will be quite clear, but there are several unusual features in the design. First, the throttle is of what is termed the " butterfly " type. Secondly, there are two submerged jets and two others arranged above the petrol level. Fig. 44 shows the general construction of the carburetter, the great feature of which is that it is designed to be completely automatic in action.

One big difference between the carburetters we have been considering and the Villiers carburetter is that the float chamber is fixed immediately beneath the mixing chamber. As will be seen from Fig. 45, the needle is not attached to the float in any way—it merely rests on top of the float and, when the level reaches the predetermined height, is pressed up against a seat. Another feature of the two-lever instrument shown is that the

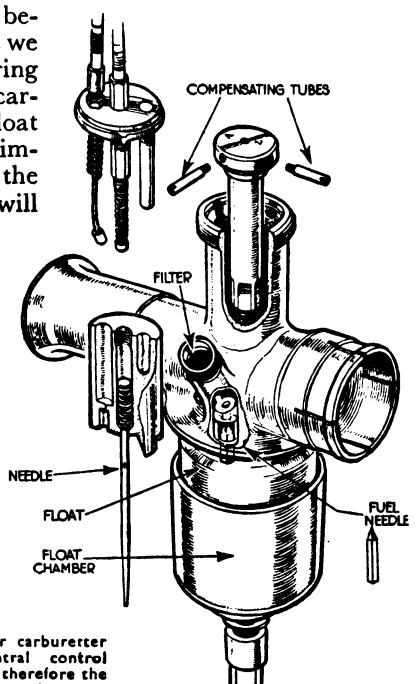


Fig. 45 : The Villiers two lever carburetter partly dismantled. The central control enables the needle height, and therefore the effective jet size, to be varied

tapered needle running in the middle of the throttle slide is controlled by the second handlebar lever—the first, of course, being the throttle control. In this carburetter there is no pilot jet. The design is simplicity itself, and the only alterations and adjustments that can be made are : the size of the tapered needle and its position, and the size of the jet.

On the single-lever model the position of the needle is varied by a small lever on top of the mixing chamber ; the needle has a quick thread and on top of the mixing chamber will be found the words " Rich " and " Weak ", indicating the directions in which the lever should be turned. With the two-lever instrument, as has been mentioned, this is accomplished by handlebar lever.

In order to prevent the mixture becoming too rich as the engine speed rises, the Villiers carburetter has a pair of " compensating tubes ", which admit air as the speed increases. These tubes, of course, must not be allowed to become choked.

Very little maintenance work is required with a modern carburetter. About the only thing the average owner ever has to worry about is seeing that the carburetter is clean internally. Dirt on the float chamber needle or its seat will obviously cause the carburetter to flood. If there is flooding which is not due to the tickler (grit between the tickler and the float chamber lid will sometimes cause the former to stay pressed down) the float should be removed and shaken, since there is a possibility that it has sprung a leak.

If shaking it proves that petrol has got inside, the best plan is to fit a new float. Quite likely the trouble is a worn needle valve, and all that will be needed is a new replacement. This is quite cheap and far more satisfactory than the result of efforts to improve the fit by grinding-in the old one with fine emery paste.

CHAPTER 5

FUELS AND COMPRESSION RATIOS

Touring and Sports Engines Compared

ONE of the main differences between touring and sports engines is that the latter have a higher compression ratio—the induced gas is compressed to a greater degree on the compression stroke. Figs. 46 and 47 show two engines, one with a compression ratio of 5 to 1 and the other with a ratio of 7.5 to 1.

The compression ratio is found by adding the capacity of the cylinder (i.e., the volume swept by the piston) to the volume of the combustion chamber and then dividing by the volume of the combustion chamber. A simple example will make this clear. Suppose that the capacity of the engine is exactly 500 c.c. and we have found by pouring thin oil into the combustion chamber that it

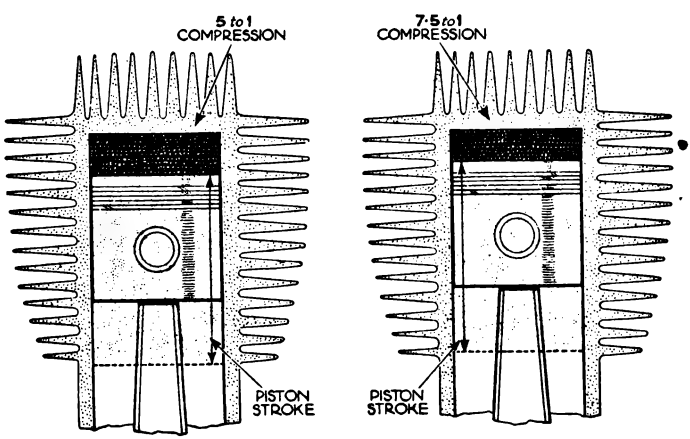


Fig. 46 : An engine, shown diagrammatically, with a compression ratio of 5 to 1, and on the right (fig. 47) one with a ratio of 7.5 to 1

takes exactly 100 c.c. to fill the cylinder head when the piston is at the top of its stroke. We therefore have (500 plus 100) divided by 100—that is, 600 divided by 100, which equals 6. The compression ratio of the engine is therefore 6 to 1.

Other things being equal, the engine with a ratio of 7 to 1 would have a greater power output; but there is a limit to the compression ratio that a fuel will stand. Go above this limit, which is called the "highest useful compression ratio", and the power output will drop, the mixture of fuel and air detonating instead of exploding. This detonation is spontaneous ignition and causes harsh metallic clanks in the engine that are generally referred to as knocking.

Another limiting factor is the degree of smoothness demanded by the rider. A high-compression engine is rougher than an engine with a low compression ratio, assuming that both units are of equally good design. In addition, as can easily be realized, it is more difficult to kick-start an engine with a high ratio than it is an engine of low ratio.

Small Cylinders—High Ratio

In passing it may be mentioned that the smaller the cylinder the higher can be the compression ratio—there is not so much tendency for a given fuel to detonate, and small cylinders mean that the engine is easier to kick over. These are two big points in favour of multi-cylinder engines.

From the foregoing it will be realized that the fuel desirable depends upon the cylinder size and the compression ratio. High-compression, big, single-cylinder engines demand fuels with a high anti-knock value, whereas touring-type multi-cylinder machines can, metaphorically speaking, be run on "any old fuel".

The characteristics of a fuel in which the user is most interested are (1) anti-knock value; (2) whether it provides easy starting; (3) whether it ensures true economy by reason of high mileage to the gallon, the minimum wear

and tear of the engine, and lack of carbon and other deposits in the combustion chamber.

It may be taken that any of the best-known brands will be satisfactory in the matter of providing easy starting, also as regards wear and tear. There remain the questions of anti-knock value and deposits. In a touring-type engine there is no special point in using a fuel blended specifically to withstand high compression ratios.

"Straight" and Anti-knock Fuels

Any first-class "straight" petrol or petrol-benzole of the type normally obtainable from pumps will be admirable, and only when the combustion chamber is badly carboned up and the engine liable to knock need there be any question of using a so-called anti-knock fuel. Really when this point is reached the engine should be decarbonized. However, if this is out of the question and the machine must be used in spite of the carbon in the combustion chamber—then an ethylised fuel or one containing alcohol or a mixture of petrol and benzole should be employed if possible. The words "ethylised fuel" mean that the fuel consists of petrol to which has been added lead in the form of tetra-ethyl lead. Lead has the property of slowing down the rate of combustion and thus preventing knocking.

Alcohol is also excellent from the point of view of obviating knocking. It is widely used in track racing, and alcohol fuels can be blended to suit any compression ratio—there are fuels suitable even for a ratio of 20 to1. Alcohol fuels are kind to an engine; they promote cool running, but for a given compression ratio, unless that ratio be high, they do not give the same mileage to the gallon as petrol. The heat content of the fuel is lower.

Finally, there is benzole, which is the usual anti-knock fuel employed in motor cycle road racing. The standard arrangement is that competitors in such races may use up to 50 per cent. benzole in their petrol. Many super-sports motor cycle engines are designed to run on this 50/50 mixture of petrol and benzole, in which case owners must normally mix the pure benzole and straight petrol

themselves, since the benzole mixtures supplied from roadside pumps seldom contain so much benzole (benzole is more expensive than petrol). Usually the mixtures obtainable from pumps have an anti-knock value comparable with that of a first-class straight petrol.

Benzole is a fairly hot-running fuel, with the advantage that it is often possible to obtain a greater mileage to the gallon than with any of the other fuels. A weaker carburetter setting is usually worth-while in the case of a fuel with a high benzole content.

Each of the special anti-knock fuels has its own particular advantages, and those who buy sports mounts with high compression ratios should use the fuel that the makers of their machines recommend. Usually, advice regarding the fuel to be used in such machines is to be found in the instruction book ; if not, a letter addressed to the makers will soon elicit a reply as to the fuel that they personally have found most suitable.

CHAPTER 6

LUBRICATION

Why Oil is Essential : Lubrication Systems

NO matter how carefully the bearing surfaces of an engine may be made, under a microscope they will appear rough. If these rough surfaces were allowed to slide over each other without any lubricant being interposed, the rubbing would cause great heat to be generated ; not only would power be wasted, but sooner or later the parts would become so hot that they expanded to such an extent that they could slide no more—in other words, the parts would seize.

The ideal lubricant and lubrication system would ensure (1) that there was no resistance to motion and (2) that the bearing surfaces were kept separated by a minute film of oil under all working conditions.

Keeping the surfaces separate is important if wear and tear are to be avoided. Some oils are better than others in the maintenance of a film when the bearing pressures are high. When what are termed " boundary " conditions are likely to arise—in other words, very high pressures may squeeze out the oil, leaving insufficient to keep the surfaces separated—the animal and vegetable oils have until recently been as a rule superior to mineral oils, but for ordinary use they are inadvisable.

A castor oil, for example, while all right for racing, in which case an engine is frequently stripped and cleaned out, should never be used by the ordinary motor cyclist. If it is used for any length of time without the engine being completely dismantled, there may be failure of the lubrication system owing to oil-ways having become choked ; in addition, the lubricant is liable to cause corrosion and to result in a very hard type of carbon.

For touring the knowledgeable leave it alone for the reasons given and also because there are numerous mineral oils just about as good in this respect and far better in

the majority of others. To-day, indeed, a number of famous racing men use mineral oils on the score of greater speed.

It is not possible for the ordinary user to determine whether an oil is suitable for his engine or not. Sight and feel are not enough. Therefore it is advisable for none but those who have special knowledge and facilities to use oil of unknown brand in their engines. The best policy is to choose a well-known brand and then to use the grade advised for the particular engine—generally the makers of one's machine make certain definite recommendations on the oil filler cap and in the instruction book.

The oil circulated in an engine has another job besides that of lubrication ; it is employed as a cooling medium.

The oil in the majority of modern four-stroke engines is fed by pressure to the bearing surfaces in large quantities and effectively carries the heat away. This has a big incidental advantage : because the bearing surfaces are kept cool, the lubricant between those surfaces maintains its body and " boundary " conditions are unlikely to arise.

Causes of Wear

Before we pass on to describe and discuss actual lubrication systems, a few words on the subject of wear are timely. Obviously, the more complete the film of lubricant between two sliding surfaces, the less will be the wear. It is, however, impossible to eliminate wear entirely. First, the film may not always be perfect. Secondly, grit and particles of metal are liable to be carried round with the lubricant. Thirdly, so far as the cylinder walls are concerned there is a tendency towards corrosion, which occurs chiefly when the engine is started up from cold.

How much wear occurs depends largely upon the combination of materials used for the bearing surfaces. In practice it is found that if the two materials are of equal hardness the wear is unduly rapid—much more rapid than when one material is hard and the other soft.

The accepted explanation of this is that when a metal is soft any particles of grit or metal that may be in circulation are squashed into the soft metal and become embedded

before they have time to do any great harm. If, however, the two materials are of equal hardness these abrasive particles are for a time only partly embedded and cause scratching and scoring.

In this connection, when wear takes place and the two materials forming the bearing surfaces are of different hardness, it is the harder of the two that shows the more wear.

Experienced riders may ask why it is that from the point of view of longevity the old-time combination of cast-iron piston and cast-iron cylinder was better than an aluminium piston in combination with a cast-iron barrel. There are, however, special factors in this case.

For one thing, there is the question of corrosion mentioned earlier. Recent experiments have shown that this is the big factor in the matter of cylinder-bore wear. Some people maintain that the adoption of scraper piston rings designed to prevent an excess of oil reaching the combustion chamber has also tended to increase wear considerably.

Lubrication Systems

Others point to the greater quantity of oil in circulation and aver that this, while good as regards cooling the engine internally, causes a larger amount of abrasive material to reach the bearing surfaces. However, the fact remains that aluminium pistons with their high conductivity have a big advantage over those made of cast iron, so we will leave questions of personal theories and pass on to the various lubrication systems in common use.

In the early days of motor cycling the standard practice in the case of the four-stroke engine was to supply the oil to the engine by means of a hand pump mounted in the oil tank. The rider was instructed to give the engine one pumpful of oil every so many miles—more frequently if the machine was being driven hard, as, for instance, uphill or against a head wind.

There are still some machines with hand-pump lubrication in use to-day, so it is worth stressing that with such a

system it is best to give "little and often"—instead of providing the engine with a whole pumpful, say, every ten miles, it is better to give it half a pumpful every five miles or a third of a pumpful roughly every three miles. This prevents the engine having an excess of oil immediately following receipt of a pumpful and next to none when it is nearing the time at which the next pumpful is due.

On being forced into the crank case by the pump, the oil with this system was merely left inside the engine, to be splashed about by the flywheels. The flywheels dipped into the oil at the bottom of the crank case and, picking it up, threw it, owing to centrifugal force, on to the cylinder wall and the underside of the piston.

To a certain extent the whole interior of the engine operated in oil mist, some of which, after collecting on the various surfaces, dropped or flowed down into holes leading to the big-end, little-end and main bearings.

Gradually the oil was used up, some passing the piston rings and finally being ejected via the silencer with the exhaust gas, and the remainder entering the timing chest and eventually passing out of the engine via the crank case release valve.

Some form of crank case release is necessary because the bottom of the piston acts as a pump in the same way as the top, which, of course, has to pump the fresh gas into the cylinder and the exhaust gas out into the silencer. Were there no crank case release the piston on descending would tend to force the oil out of the various crank case and timing case joints.

Oily Engines

This, incidentally, gives a clue to those whose engines have oily exteriors. If the joints have been properly made and the piston rings and cylinder are in good condition, it is almost certain that the cause is that the crank case release valve is failing to work, probably because it is choked.

Where oil is supplied to an engine and left to its own devices in the way that has just been described, the engine is said to operate on the "total loss" system. There

are many machines on the road with this arrangement—even modern machines—but, of course, the method of delivering oil to the engine has been improved.

The Drip-Feed

From the era of the plain hand pump, motor cycle design passed to that of the semi-automatic drip-feed. There was still a hand pump, but in this case all the rider had to do was to set the needle valve of the sight drip-feed so that so many drops of oil passed through to the engine per minute, and to press down the spring-loaded hand pump as soon as the pump handle reached the top of its travel.

The spring and the needle valve ensured that the engine received oil, drop by drop, always assuming that the rider remembered to press down the pump handle when necessary (and to replenish his oil tank !). Thus the engine received its supply "little and often". Inside the engine the method of distributing the oil by splash was, of course, the same.

As a system, this semi-automatic drip-feed method was excellent, but before long manufacturers decided to relieve riders of even the minor feat of remembering to push down the pump handle as soon as, or shortly before, the pump was empty.

A sight-feed was still used in many instances, but the engine did the pumping by means of a mechanical pump mounted on the timing chest—later on, for neatness sake, it was incorporated inside the timing chest. Thus the rider had nothing to remember except occasionally to check that the pump was working and the oil tank not empty.

The pumps employed varied considerably in detail design, but in nearly every instance incorporated some form of a little piston or plunger worked by gearing from the timing gear.

With increasing engine speeds it became apparent—particularly in racing—that the splash system of lubrication was too haphazard. Oil, it was decided, must be forced to the various points at which it is needed, particularly to the big-end bearing.

Thus it became the practice to lead the oil into the timing side of the crankshaft, along a hole drilled in the middle of the shaft, and through holes in the flywheel and crankpin to the big-end bearing. The remainder of the bearing surfaces were still lubricated by splash in the majority of cases, but before long the scheme of force-feeding important bearing surfaces was extended.

Now in racing engines it is the practice to provide special feeds to almost every working part—a plan which is being widely adopted in the case of standard production machines. Generally, for the sake of neatness, the oil is conveyed to the various parts by drill-ways in the crank case and cylinder or by internal pipes, thus ensuring a clean-looking exterior.

Coinciding with developments in these directions there has been a widespread adoption of what is termed the dry-sump system. The splash system is the "wet-sump", for all oil that is supplied to the sump—the crank case—remains there until used up.

The Dry-sump System

In the dry-sump system all oil that drops to the bottom of the crank case is removed by a scavenging pump and returned to the oil container, which may take the form of a separate tank or a separate part of the crank case. Thus the sump is kept "dry" and free from surplus oil, and the oil—large quantities of it—is kept in continuous circulation.

The advantages of this system are that there is less flywheel drag—the flywheels operate in a more-or-less dry crank case—and the bearings are flooded with cool oil which carries the heat away. This last point is based on the assumption that the oil does have the opportunity of cooling off before it once again is supplied to the engine.

Obviously any grit in the oil will keep on finding its way into the engine unless there is an efficient filter. What is not so obvious—or, at all events, is not sufficiently widely appreciated—is that the oil, in circulating through the engine, loses some of its important assets and also

becomes contaminated with water, dirt and any heavy fractions of the fuel that may pass the piston rings.

Thus, after considerable use, the oil, instead of being an effective lubricant, has become a vehicle of wear. It must be changed at frequent intervals and the tank or sump and all filters cleaned out.

To carry on using the machine, merely adding oil as the level in the tank or sump drops, is to ask for trouble, which will come for certain in the form of rapid wear of the engine parts.

Most of the bearing failures in recent years, and nearly every one of the cases in which owners have groused about the small mileages they have been able to cover before putting their hands in their pockets, are ascribable to the riders concerned failing to carry out the makers' instructions regarding draining tanks, etc., flushing out and replenishing with fresh oil. Far from saving money by omitting to throw the stale oil away, these riders are wasting pounds.

Lubrication Tips

Having stressed this extremely important point, we will pass on to various hints and tips regarding lubrication in general and the dry-sump system in particular. First, it is always as well to watch out that you receive the oil you order and that the measure is not dirty. Secondly, it is much cheaper to buy oil in five-gallon drums—or even by the gallon—than to purchase it in odd pints. Thirdly, it is an economy to drain the tank when the oil level is fairly low.

When it comes to draining, always do this immediately after a run, because then the oil will be warm and therefore flow easily. The flushing out can be carried out by means of one of the special flushing oils, or petrol may be used. Paraffin is not a good flushing medium.

It is easy to find out whether a full dry-sump lubrication system is functioning by checking off whether any oil, in the form of a mixture of oil and air, is being returned to the tank via the return pipe. The fact that the oil spurts forth together with air bubbles need cause no

worry. The return pump has to be of greater capacity than the supply pump otherwise it would never be able to keep the crank case properly scavenged.

With modern machines troubles with the lubrication system are few and far between so long as the routine task of draining, flushing, etc., is duly carried out. The most likely difficulty is that the system fails to work immediately following the flushing out.

As a rule, the reason is that the man concerned has failed to prime the pump by filling up the pipe which leads oil from the tank to the pump. With some designs it is essential to fill this pipe with oil, following the tank being drained, and to see that none of this column of oil disappears as the pipe is fixed in position. In certain cases the pipe will fill of its own accord if, after the tank being filled, the lower end of the pipe be removed for a moment.

Do Not Overfill

The tank should not be filled to the brim because, owing to the return pump delivering air and oil mixed, there will be a tendency for the tank to overflow. Incidentally, if there is a vent hole in the filler cap, it is as well to see that it is kept clear.

Perhaps the most worrying trouble experienced by those whose systems incorporate a sight feed is when the sight feed fails to keep clear. This may be caused by a non-return valve at one of the sight-feed unions being faulty or not seating properly, but more likely there is an air leak at the sight-feed glass, which means that the joint must be remade with seccotine or some other jointing compound, and perhaps new washers.

Earlier in this chapter mention was made of plunger-type oil pumps. Twin plunger pumps or pumps with double-acting plungers are the usual practice (Fig. 48), but quite a number of machines employ gear-type pumps. These are simple and foolproof. They consist of pairs of gear pinions snugly fitted in a casing (Fig. 49). Consider the upper pair of pinions. Oil is drawn from the tank and the teeth on the pinions carry it round the casing and force it out of the duct and into the engine.

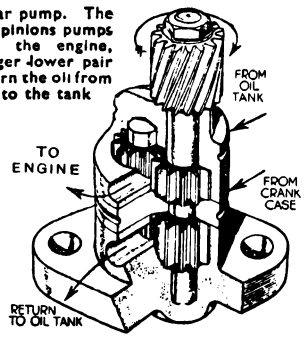


Fig. 49 : A gear pump. The upper pair of pinions pumps the oil into the engine, while the larger lower pair is used to return the oil from the engine to the tank

At high pressures there is inevitably leakage past the teeth (which must have clearance in the casing), but so long as the pump is below the level of the oil in the tank, and therefore does not have to prime itself, it is very satisfactory in practice.

So far we have been considering four-stroke engines only. The dry-sump system cannot be employed for the normal two-stroke, since this type of engine uses its crank case as a pumping chamber for drawing the petrol-air mixture into the engine and pumping it into the combustion chamber.

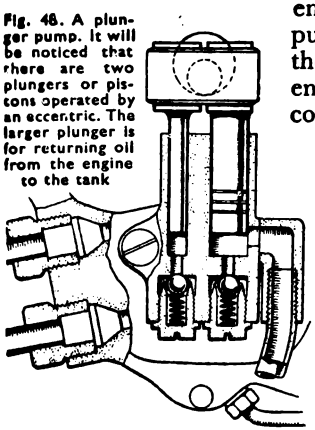


Fig. 48. A plunger pump. It will be noticed that there are two plungers or pistons operated by an eccentric. The larger plunger is for returning oil from the engine to the tank

Also the plain hand-pump system is ruled out because were a pumpful of oil supplied to the crank case this would straightaway pass with the mixture into the combustion chamber and thence to the silencer and open air.

However, a drip feed or a plain mechanical pump can be employed. This latter arrangement is standard practice on a number of two-strokes ; it is simple and satisfactory. Even simpler are the two other methods that are frequently encountered. The first is the petroil system in which oil is mixed with the petrol. This oil finds its way with the petrol into the carburetter and thence into the crank case where it reaches the various bearing surfaces in the form of mist.

The great advantage of the petroil system (which, of course, can only be employed for two-strokes that use

their crank cases as pumping chambers) is that the amount of oil is proportional to the work that the engine is doing. For example, if the machine is being driven hard up a steep hill it is consuming more fuel ; therefore the engine is receiving more oil. If it is merely being driven at 20 m.p.h. on the level it is receiving next to no oil.

There are, of course, disadvantages. First, every time that petrol is purchased, the correct amount of oil has to be poured into the tank and the two properly mixed (In the case of an autocycle, which normally has a deep tank, it is desirable to mix the petrol and oil before they are poured into the tank). Secondly, the oil is liable to settle in the carburetter if the machine is left for any great length of time.

This can be obviated by the rider turning off the fuel tap a few hundred yards before the end of his journey, which

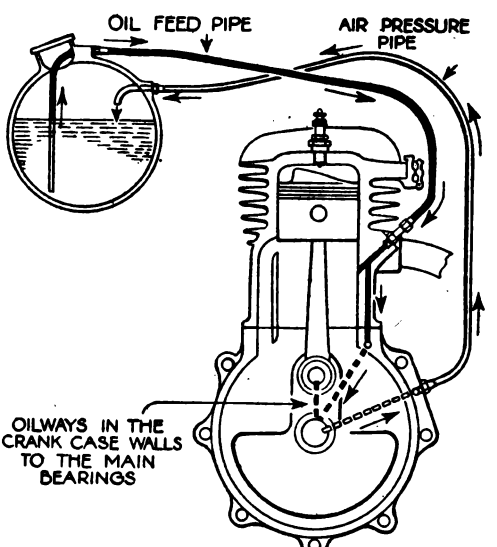


Fig. 50 : The Villets automatic lubrication system

will ensure that the carburetter is left nearly empty and will facilitate starting up when next the machine is needed.

In addition, some people believe in giving a petroil-lubricated machine one or two swings sideways to mix up the oil and petrol—that is, if the machine has been out of use for a day or two.

Two-Stroke Lubrication

Third on the list of points levelled against the petroil system is that it is messy—every time the carburetter is flooded the exterior receives a film of oil that collects dust ; also oil is liable to be blown back from the carburetter air intake on to some part of the machine or even one's trousers. This last is no longer a trouble on certain machines ; special intake and port designs make certain that either there is no blow-back, or that the blow-back is directed out of harm's way.

Finally, there is the Villiers automatic system. This consists of a form of automatic drip feed, the oil being forced through an adjustable sight feed and thence to the engine by means of pressure supplied from the crank case. For this sytem to work properly the oil tank must be a pressure-tight chamber. Therefore the filler cap must be screwed down hard and have a perfectly sound washer. Fig. 50 shows the system more clearly than any words.

CHAPTER 7

ELECTRICAL SYSTEMS

Ignition—Magneto and Coil : Lighting : The Battery

TWO types of ignition system are employed in the motor cycle world. First, there is the high-tension magneto and, secondly, coil ignition. Except that a magneto generates its own low-tension, that is, low-voltage, current, whereas the coil set draws its supply from the storage battery on the machine, the two systems have much in common.

In each instance we have a coil of thick insulated wire wrapped around by a coil consisting of thousands of turns of thin wire. These are termed the " coil " in a coil ignition set and the " windings " in the case of a magneto. Each functions in the same way : a low-tension current is passed through the thick wire and, at the exact fraction of a second at which a spark is required in the cylinder, the current is interrupted by means of a device called a " contact-breaker ". This causes a current of very high voltage to be induced in the fine wire—the secondary winding—and a spark to jump across the gap between the sparking plug points (the plug being, of course, connected to the fine wire).

The magneto, as mentioned already, generates its own primary current. The method is quite simple. Advantage is taken of the fact that when a coil of wire is rotated between the poles of a magnet, electricity is automatically generated in the wire. This also occurs if the coil of wire is stationary and the magnet is made to revolve. The majority of magnetos are designed so that the wire—in other words, the windings—rotate, but there are many instruments, notably the flywheel type of magneto, in which the magnets revolve and the actual windings remain stationary.

The magnet employed is a permanent magnet, that is, it retains its magnetism indefinitely. It may be shaped like a horseshoe or consist of two parallel bars. Special alloys are used for the purpose.

In the case of coil ignition the storage battery fulfils a dual function; it not only provides the current for the coil, but also acts as the battery for the lamps on the machine. It receives its electricity, of course, from the generator or dynamo. If the battery contains no electricity or through some other disarrangement there is no supply of current, the coil ignition set will not function. One is dependent upon the battery, and also upon the actual source of electricity, the dynamo.

The recent adoption of battery-controlled charging, which helps to ensure that the battery is always properly charged up and enables the machine to continue to journey's end with the battery out of order so long as the dynamo is working, has tended to put an end to such trouble. So far as the rest of a coil set is concerned there is, or at least should be, less likelihood of trouble than with a normal type of magneto.

Advantage of the Magneto

A big advantage of the magneto is that it is one self-contained unit. Its chief disadvantage is that it has to be rotated above a certain minimum speed in order to provide a spark; the intensity of the spark makes little difference—so long as there *is* a spark the engine should fire. With the standard form of instrument in which the windings revolve, the spark is not so certain when the ignition control is retarded as it is when fully advanced (with flywheel magnetos there is no difference).

In actual practice, however, this criticism of the magneto amounts to little, since with modern instruments, assuming that they are in sound order, a spark occurs even at the low speeds that result from gentle use of the kickstarter.

With a coil set the value of the spark is at a maximum when the engine is turning over very slowly, and is so

irrespective of the position of the control operating the advance-and-retard mechanism. This means that a coil ignition helps to ensure exceptionally easy starting, but, on the other hand, such a set is not as a rule so good as a magneto when it comes to very high engine speeds.

For touring machines the coil set should be preferable ; it is cheaper in first cost, gives the easiest possible starting if the battery is fully charged, and makes use of two components that are already on the machine for the lights, namely, the dynamo and the battery. In practice this has not always proved the case in the past. There has also been the innate conservatism of the motor cyclist. The adoption of the afore-mentioned automatically controlled charging has marked a big step forward.

From the brief discussion of the respective merits of the two systems and their method of operation we will pass on to examine the actual construction of a normal type of magneto. Fig. 51 shows a magneto with a horseshoe magnet, in diagrammatic form. On the left the whole instrument has been sectioned—actually cut, except for the windings, down the middle—to show the internal construction, while on the right is an end view showing the contact-breaker. This latter view reveals the horseshoe

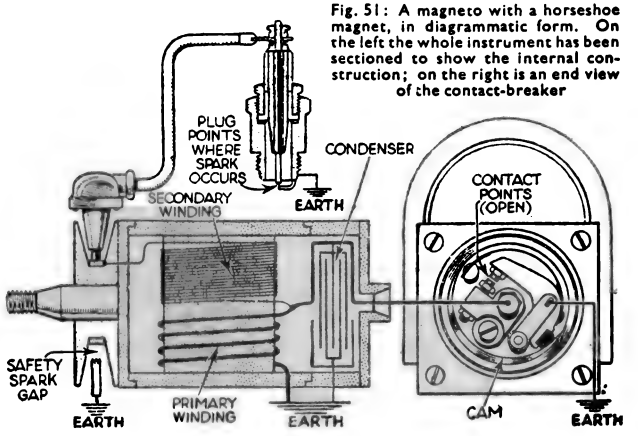
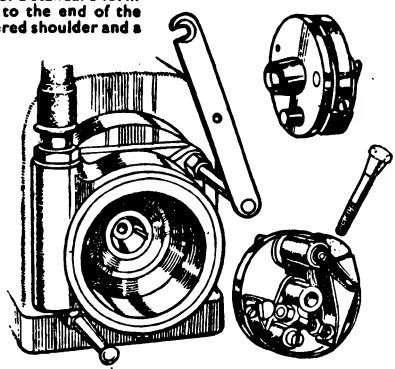


Fig. 51: A magneto with a horseshoe magnet, in diagrammatic form. On the left the whole instrument has been sectioned to show the internal construction; on the right is an end view of the contact-breaker

Fig. 52 : The detail construction of a standard form of contact breaker ; it is attached to the end of the armature spindle by means of a tapered shoulder and a steel screw



magnet, which forms a tunnel for the armature that carries the windings. The thick primary winding will be noticed, also the thin secondary winding. The armature on which these coils of wire are wound runs in ball bearings which are carried in end-plates that close the front and rear of the tunnel.

It will be noticed that a condenser is contained within the actual armature of the magneto. This consists of sheets of tinfoil separated by mica or other insulation. If there were no condenser, not only would the platinum (or Tungsten) contact points on the contact breaker soon become burnt, but there would not be such a certain spark at the sparking plug.

The trouble is that the primary current has a strong inherent tendency to continue to flow after the time at which it should have ceased by reason of the platinum points having separated. If there were no condenser there would be arcing at the platinum points and the spark would not be so " good " because the current in the primary " dragged " on instead of being suddenly interrupted. All the condenser does is to absorb the current that would otherwise tend to jump across the points. If there is any serious sparking at the points under working conditions, and the points are clean, it is almost a certainty that the condenser is faulty and should therefore be replaced with a new one.

Fig. 52 shows the detail construction of a standard form of contact breaker. It is attached by means of a tapered shoulder and a steel screw (seen on the right) to the end of the armature spindle. To remove the contact breaker

from a magneto it is only necessary to unscrew the hexagon-headed screw and then, if the contact breaker will not pull away with the fingers, withdraw the screw for about a third of its length and thrust it from one side to the other—this invariably frees the contact breaker on its tapers and causes it to come adrift.

Since the contact breaker is carried in the end of the armature shaft it automatically revolves with the armature. The contact breaker shown in the illustration is designed to rotate in a clockwise direction—the fibre heel on the rocker arm is then trailing. As the fibre heel strikes the cam the points automatically are forced apart. This is the point at which the spark occurs at the sparking plug points. Since the spark in the cylinder has to occur when the piston has reached a certain definite position in its travel, care is obviously necessary over the task of connecting up the magneto drive from the engine—this is termed "timing the magneto", a matter that will be discussed in detail in a later chapter.

The Earthing Brush

Behind the contact breaker there is usually a little cylindrically-shaped piece of carbon, called a "brush", with a spring that presses the brush on the end-plate of the armature. The object of this brush is to provide an easy path for the low-tension current. Were it not present the current would have to go via the ball bearings that support the armature, and these are packed with grease and therefore by no means good as conductors of electricity. Many motor cyclists have found that it seems to make no difference to their magnetos whether this earthing brush is in position or not; nevertheless, if lost or faulty, it should be replaced with a new one.

At the other end of the magneto there is another carbon brush—the collector brush which "picks up" the high-tension current from the slip-ring and conveys it via a thick rubber-covered cable—the high-tension (h.t.) lead—to the sparking plug. The slip-ring consists of a ring of brass at the base of a moulded vee-shaped ring formed of insulating material. The slip-ring is merely a press

fit on the armature spindle and is, of course, mounted inside the armature tunnel.

So far we have been considering a magneto designed for a single-cylinder engine. In the case of a twin the magneto has two contact-breaker cams and instead of there being a continuous brass ring at the slip-ring, this latter has only a brass segment.

A magneto provides two sparks per revolution, and when there are four cylinders it is necessary to fit what is called a "distributor". Fig. 53 shows a distributor for a four-cylinder engine. In the middle is a rotating metal finger, and the spark jumps from the finger to the contacts in the side of the distributor body which are electrically connected to the four plugs via the four h.t. leads.

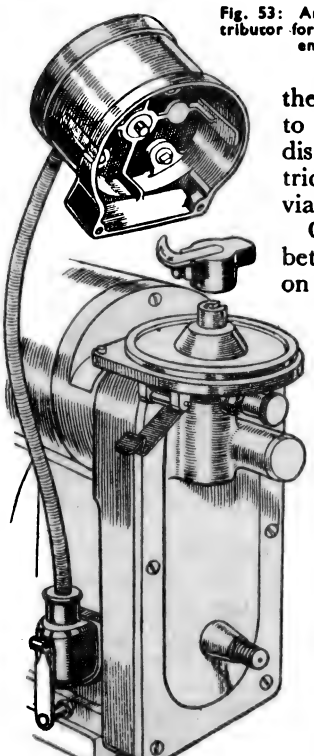


Fig. 53: An ignition distributor for a four-cylinder engine

One feature that had perhaps better be mentioned before we pass on to other forms of ignition is the safety gap. This often takes the form of a little screw fixed in the body of the magneto, and protruding up the vee of the slip-ring, so that its point lies close to the slip-ring. The reason for its presence is to enable the h.t. current to jump safely to "earth"—that is the body of the magneto—in the event of the electrical circuit not being completed via the plug (say, the h.t. lead is lying loose); thus there will be no chance of the windings on the armature being damaged. As will be mentioned in the

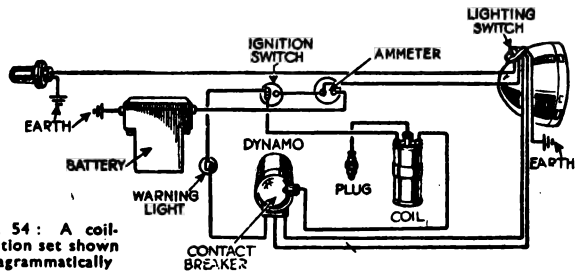


Fig. 54 : A coil-ignition set shown diagrammatically

chapter dealing with dismantling a magneto, it is essential to remove any safety-gap screw before setting about the task of taking a magneto to pieces.

Assuming that the general design of a normal type of magneto is now quite clear, no difficulty will be experienced in grasping the essentials of the flywheel magneto, or those of the coil-ignition set (Fig. 54). In the case of the latter the coil, which as mentioned earlier is equivalent to the winding of a magneto, is mounted on any convenient part of the machine—preferably somewhere that is likely to prove perfectly dry. The contact breaker as a rule is housed either at the end of the dynamo or in the timing chest of the engine. In the former case the dynamo must be driven at the speed of the engine or at half engine speed ; it cannot be driven at $1\frac{1}{3}$ engine speed, which is about the usual speed of a dynamo, or the spark will not occur at the required time—the spark would occur once in every $1\frac{1}{3}$ revolutions instead of once every revolution or every other revolution as is required by a two-stroke and four-stroke respectively !

In Chapter 1, when discussing how an engine works, we said, " On the piston reaching the top an electric spark, automatically produced by the magneto, jumps across the points of the sparking plug and ignites the compressed gas ". This is not *strictly* true ; the spark has to be timed to occur slightly before the piston reaches the top of the compression stroke. The reason for this is that it takes an appreciable time for the compressed gas to become completely ignited and for the full force of the

explosion to develop. How long this period of time is depends upon the design of the particular engine. With a 500 c.c. overhead-valve single it is quite usual to arrange that the spark occurs when the piston is $\frac{7}{16}$ in. before the top of the compression stroke when the ignition control is fully advanced.

The term "fully advanced" needs explaining. You will recall the cam that operates the contact breaker. Assume that you could move this cam round in its housing; it would alter the timing, would it not—causing the spark to occur earlier or later according to the direction in which the cam was moved? Well, this is exactly what is done in practice, though in the case of an actual motor cycle the cam is moved round by means of a Bowden flexible wire control. Fig. 55 shows a fairly typical advance-and-retard mechanism and how it works.

Why Vary It?

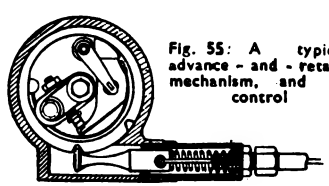


Fig. 55: A typical advance-and-retard mechanism, and its control

The reason for the advance-and-retard mechanism is that an engine needs more ignition advance when it is running fast than it does at low speeds. If the ignition were timed to the best advantage for low speeds we should find that at high speeds the engine was not developing anything like the greatest possible power, because, owing to the time-lag in the complete ignition of the gas, the full power of the explosion would not be reached until the piston was well on its way down the power stroke.

The best timing for a particular engine is a matter determined by its makers by a series of experiments. Usually the timing is expressed in inches or millimeters of piston displacement. Thus you may find that the instruction book applying to your particular machine states: "The platinum points should start to separate when the piston is $\frac{7}{16}$ in. before top dead centre, the magneto being fully advanced". When it says "top dead centre" it means the top of the compression stroke. With

high-efficiency engines sometimes the timing is expressed in degrees of crankshaft rotation—that is, how much the crankshaft must be turned backwards from the position it occupies when the piston is at the top of its stroke.

Before we pass on to dynamos a few words are needed on the subject of sparking plugs. Fig. 56 shows a fairly typical sparking plug, cut away to reveal its construction. The body of the plug is made of steel, and screws into the combustion chamber of the cylinder. In order that there shall be no leakage of gas a special washer is placed between the flange of the plug and the cylinder base. This washer consists of thin sheet copper enclosing asbestos and, being automatically compressed by the action of tightening down the plug, ensures a perfectly gastight joint. The insulation of the plug is either mica or some porcelain-like substance, such as steatite. The spark jumps from the central electrode (which may be of copper, nickel or some special steel) to the side or "earth" electrode. In some designs there is one side electrode or "point"—in others either two or three. The advantage of the latter is that there are alternative paths for the spark to jump and thus it will be longer before there is need for adjustment because the points have burnt away until their gap is too large. On the other hand a blob of oil or a sooty deposit has more chance of finding a home and putting the plug temporarily out of action when there are several points than when there is only one—everything in this world is a compromise !

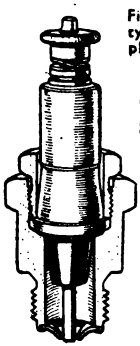


Fig. 56 : A touring type of sparking plug in part-section

A dynamo in its method of operation is not unlike the low-tension side of a magneto. Instead of there being only one low-tension winding on the armature, in the case of a dynamo there is a number ; each of these becomes charged with electricity, which is passed on to a commutator, whence it is collected and transferred to the battery. Fig. 57 shows the construction of the armature and commutator, while Fig. 58 illustrates one of the

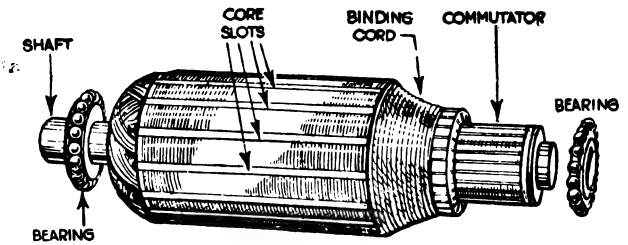


Fig. 57: The armature and commutator of a dynamo

spring-loaded carbon brushes that collect the current from the commutator.

The commutator is built up of a number of copper stampings, separated from each other by mica insulation. The armature itself is also built up of stampings—special slotted ones designed to carry the wire that forms the windings.

As is the case with a magneto the armature of a dynamo is carried in ball bearings. One big difference between the two types of instrument is that the latter has electro magnets instead of permanent ones—in other words, the instrument provides its own magnetism by means of coils of wire surrounding the poles.

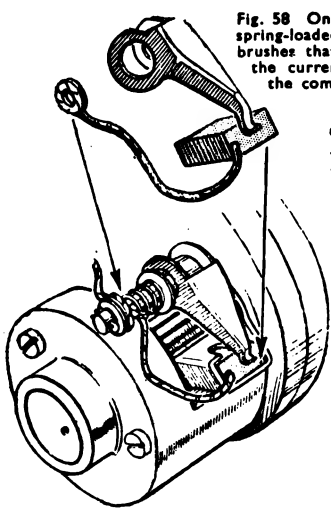
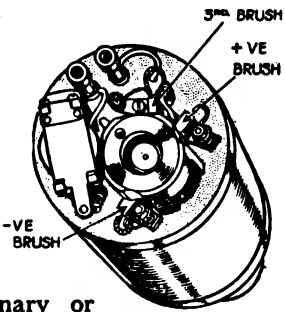


Fig. 58 One of the spring-loaded carbon brushes that collect the current from the commutator

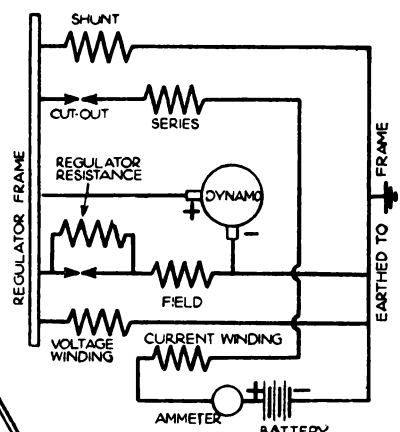
The current collected from the commutator does not pass directly to the battery, but via an electro-magnetic device, termed a cut-out, and an ammeter, which is an instrument that shows the amount of current. The cut-out is a device that automatically disconnects the dynamo from the battery when

Fig. 59: The arrangement of the collector brushes on a Miller dynamo



the speed of the dynamo falls below the point at which it can charge the battery. When the speed of the dynamo rises again the cut-out points close and current once again flows to the battery. Were it not for the cut-out the battery would discharge through the windings when the dynamo was stationary or running very slowly—in other words, the cut-out is a safety device and, since it has to be set to operate at certain definite voltages, no attempt should be made to " adjust " it.

Fig. 59 shows the arrangement of the collector brushes on a well-known type of dynamo. It will be noticed that three brushes are pressing upon the commutator. The brush roughly midway between the



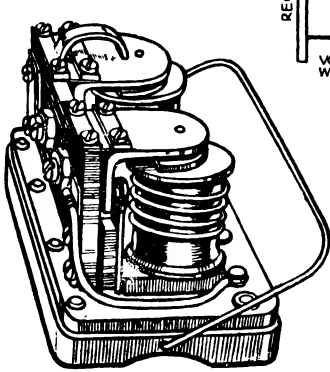


Fig. 60 : Technical details of the Lucas system of battery-controlled charging with compensated voltage control. On the left is a regulating unit comprising the voltage control and cut out

positive and negative brushes is called the " third " or " control " brush. Its object is to short-circuit part of the armature when the speed of the dynamo rises to such an extent that the current might be too much for the windings.

Until 1936 this method of controlling the dynamo output was standard on nearly every British dynamo designed for motor cycle use. The latest development is what is called battery-controlled charging. In this case the dynamo output depends upon the state of the battery ; if the battery is " low " the dynamo output becomes comparatively high, while should the battery be fully charged the dynamo output drops almost to nothing. Fig. 60 shows the technical details of this type of system, which is a boon inasmuch as the charging is entirely automatic and therefore not only is the battery maintained in the best possible state and not overcharged (a frequent cause of trouble with the small batteries fitted to motor cycles), but also it obviates worry on the part of the rider as to whether he or she is charging the battery adequately or too much.

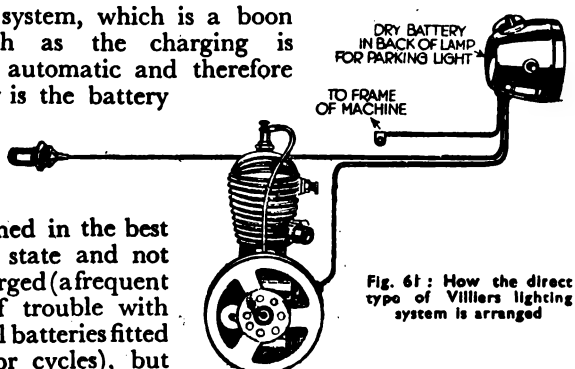


Fig. 61 : How the direct type of Villiers lighting system is arranged

In many designs the dynamo and magneto, while electrically two separate instruments, are built as one unit. Additionally there is an ingenious form of combined dynamo and magneto which utilizes the same armature for both lighting and ignition. This is called a " Maglita ", and is described in detail in Chapter 36, which discusses its care and maintenance.

Another much-used system of lighting is the Villiers, which is probably the most simple of all. In this case there are merely lighting coils incorporated within the

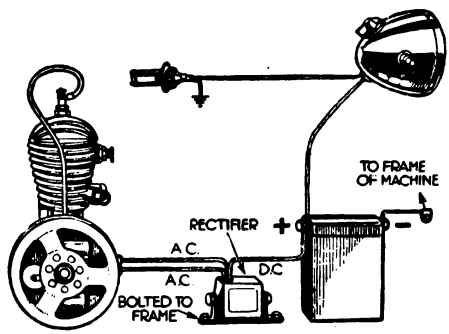


Fig. 62 : The Villiers charging set with its Westinghouse all-metal rectifier

flywheel magneto. Fig. 61 shows the general arrangement of the direct type of Villiers set. There is no battery, except a dry battery for parking purposes, and whenever the switch is on and the engine rotating one has a light. Recent developments have resulted in a type of system that provides a driving light equivalent to that of a full dynamo set.

The current generated in this case is alternating and not direct ; therefore it cannot be used for charging a battery unless a rectifier is fitted. Such a device is available if desired, and Fig. 62 shows the standard Villiers charging set with its Westinghouse all-metal rectifier ; this has advantages over the direct-lighting system in that it enables an electric horn to be employed and obviates the need for a dry battery for parking purposes.

So far, while storage batteries have been mentioned in passing, nothing has been said regarding their construction. The type of battery fitted to nearly all motor cycles is the lead-acid battery, such as is illustrated in Fig. 63. This is a six-volt battery, that is, one consisting of three cells, each with one set of positive plates and one set of negative plates. These latter are of pure lead, while the former consist of lead grids pasted with peroxide of lead. The " acid " is sulphuric acid diluted with distilled water.

The action of the battery is as follows : As the battery discharges the acid combines with the peroxide of lead and forms lead sulphate, until finally when the battery is completely discharged little is left but distilled water. When the battery is charged up again it automatically

regains its original state. This change in the density of the acid is a boon to those who have machines that are not fitted with battery-controlled charging, since it enables them to determine the exact state of charge of their batteries—whether they are or are not keeping them properly charged. The instrument for this is a hydrometer, which is obtainable for a few shillings from any accessory or electrical firm. No more need be said on the subject at this juncture, since the process is described fully in Chapter 34, which deals with the care and maintenance of batteries.

One other type of battery is sometimes found on motor cycles, namely, the nickel-iron battery (the Ni-Fe). In this case the positive plates consist of nickel-steel containers packed with nickel hydrate and flaked nickel, while the negative plates are filled with powdered iron oxide. The solution is composed of caustic potash and distilled water. In no circumstances must traces of sulphuric acid be allowed to find its way into the distilled water that is used for topping up the cells to make up for any loss owing to evaporation.

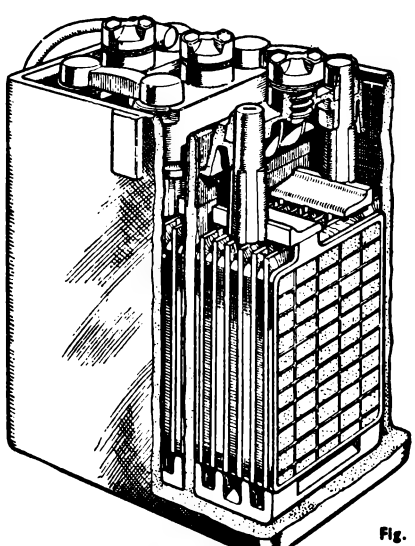


Fig. 63. The plates of a typical six-volt lead-acid battery

The big advantage of this type of battery is its strength, both electrically and mechanically—it will stand up to almost unlimited abuse. Against this, however, must be set these two facts : it is more expensive in first cost than the lead-acid type of battery and it is also more bulky.

CHAPTER 8

THE TRANSMISSION

Why a Gear Box is Needed : The Final Drive : How the Gears Work : The Clutch and its Operation

SEVERAL forms of transmission are employed on modern motor cycles. All have gear boxes in order to compensate for the fact that the power a petrol engine develops depends upon the speed at which it is rotating. If the petrol engine were a truly flexible engine and capable of producing the same power at low as at high engine speeds, no gears at all would be necessary.

While by means of flywheels, scientific design and, in the case of some machines, multi-cylinder engines, much has been accomplished towards making petrol-engined vehicles flexible, a gear box is still needed for hill climbing and starting from a standstill. In the latter case a device is necessary in order that the vehicle may start smoothly from rest—a means of enabling the engine to take up the drive, in other words, a clutch.

Figure 64, showing a fairly typical power curve of a 500 c.c. engine, reveals how the power output varies with the engine speed. It will be noticed that at 3,500 revolutions a minute the engine is developing roughly three times the power it provides at 1,000 revolutions a minute. It will also be noticed that the power curve starts to drop after an engine speed of 5,400 r.p.m.

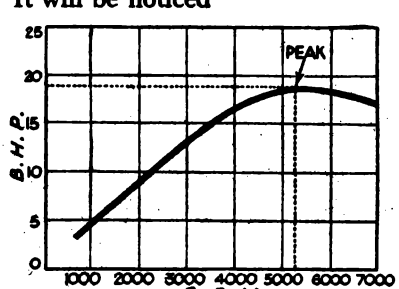


Fig. 64 : A typical power curve, for a 500 c.c. engine

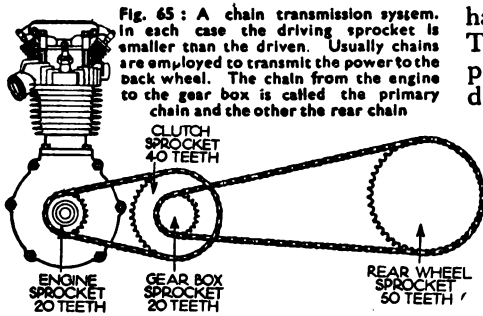


Fig. 65 : A chain transmission system. In each case the driving sprocket is smaller than the driven. Usually chains are employed to transmit the power to the back wheel. The chain from the engine to the gear box is called the primary chain and the other the rear chain

has been reached. The maximum power is thus developed at 5,400 r.p.m. (this is called the "peak of the power curve" of the particular engine). Since the engine has to rotate at such high speeds in order to develop its maximum power, and it is necessary for the engine to reach these speeds if the best possible performance is to be obtained from the machine in which it is fitted, the engine has to be geared down in relation to the back wheel. Normally, when a machine of 500 c.c. is in top gear, for each revolution of the rear wheel, the engine rotates about five times—more in the case of a sidecar machine or one with a smaller engine. We speak of such a motor cycle having a top gear ratio of 5 to 1. The top gear is usually arranged so that the engine enables the machine to attain the maximum possible speed on the level, that is, the top gear is such that the engine can just reach the r.p.m. that give the greatest power output.

With the majority of motor cycles this top gear reduction is obtained by means of chains and sprockets. There is one roller chain (like a bicycle chain, only, of course, stronger and heavier) between the engine shaft and the gear box, and another between the gear box and the rear wheel, and in each case the driving chain-wheel or sprocket is smaller than the driven one. The diagram (Fig. 65) will make this quite clear. If the number of teeth on the engine sprocket in the illustration was counted it would be found that there are twenty as against forty on the clutch sprocket ; therefore, the engine rotates twice as fast as the clutch.

The rear chain-wheel illustrated has fifty teeth, while the gear box sprocket that drives it has only twenty teeth ;

thus the latter rotates at two-and-a-half times the speed of the rear wheel. Consequently we have a gear reduction of 2 to 1 in the primary drive, and 2½ to 1 in the secondary drive. These multiplied together give a total gear reduction between the engine shaft and the rear wheel of five; that is, the top gear ratio is 5 to 1 and the engine makes five revolutions for every revolution of the rear wheel. The other gear ratios are provided by gears mounted inside the gear box, as will be seen later.

While the transmission system just mentioned, namely, the employment of two separate chains, is to be found on most motor cycles, there are some machines which have gears instead of a chain as the primary drive (Fig. 66) and others which have the gear box bolted directly on the engine or made in one with it. In addition, certain machines have shaft and bevel gears as the rear or secondary drive (Fig. 67).

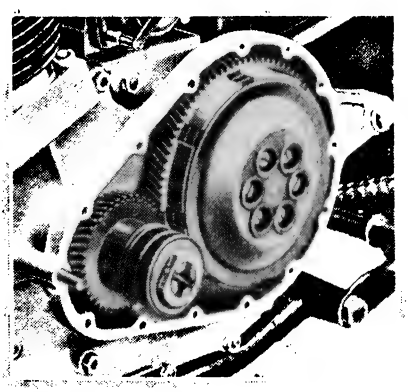


Fig. 66. Gears used as the primary drive, instead of a chain

The reason for these latter forms of transmission is to eliminate chains, which, while providing a drive of extraordinarily high efficiency, are apt to require a certain amount of attention in the way of lubrication and adjustment. In actual fact the wholesale adoption of oil-bath chain cases for the high-speed primary chain has eliminated much of the objection to chain drive, since, as a result, thousands of miles can be covered without the rider ever having to bother about adjusting his primary chain—a job which, to use a colloquialism, is a "bit of a fag", since it also involves adjustment of the rear chain.

This latter task is generally accomplished by drawbolts of the bicycle type, twin-screws that press on a collar on the rear wheel spindle, or cam-shaped

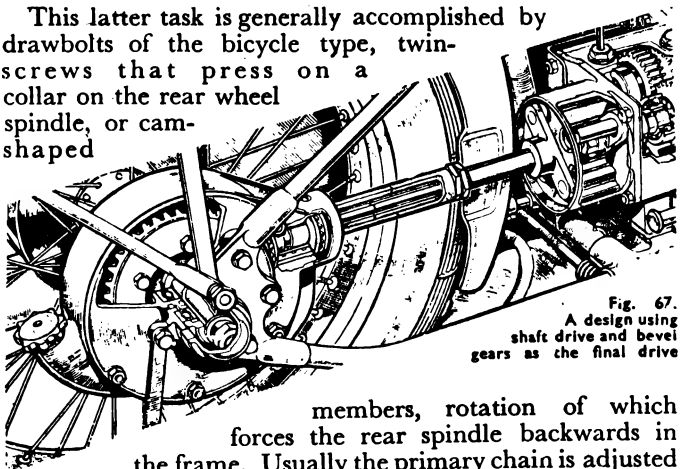


Fig. 67. A design using shaft drive and bevel gears as the final drive

members, rotation of which forces the rear spindle backwards in the frame. Usually the primary chain is adjusted by moving the gear box axis backwards in the frame, the gear box being pivoted in the frame specially for the purpose (Fig. 68).

Sometimes a double, or duplex, chain is employed for the primary drive instead of the single type. Except in a few instances, as, for example, where machines are being used for racing, or the design is such that the makers intend that the chain shall never be adjusted, it is the rule to employ a length of chain with the ends linked together with what is called a spring link

Fig. 68: The primary chain is usually adjusted by moving the gear box axis backwards; the box is pivoted to allow this

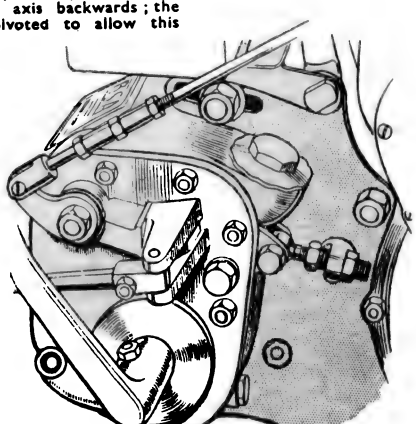


Fig. 69 (right): A spring link is generally used to join the ends of a driving chain

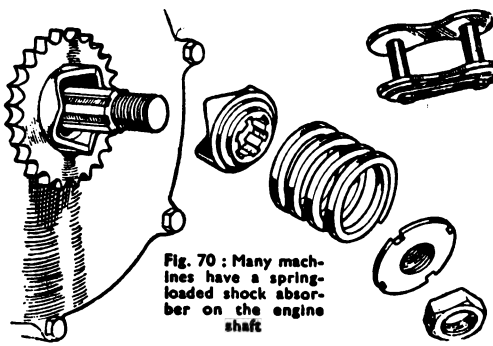


Fig. 70: Many machines have a spring-loaded shock absorber on the engine shaft

(Fig. 69). These to-day are absolutely reliable and the only point of importance is that the open end of the spring clip faces away from the direction in which the chain travels, so that if it fouled any part of the machine or, in the case of the rear chain, a stone that happened to be thrown up, the spring clip would be forced home rather than flicked off.

The comparative inflexibility of the petrol engine has been mentioned earlier. To make up for this it is usual to provide one or more cushioning devices in the transmission system. In many designs there is a spring-loaded shock absorber on the engine shaft (Fig. 70), and rear wheels and clutches often have a rubber-buffer type of shock absorber (Fig. 71 shows one design).

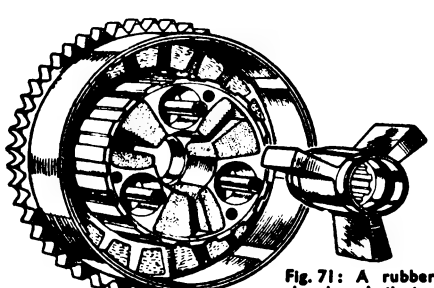


Fig. 71: A rubber-buffer shock absorber built into the clutch

If the method of operation of the

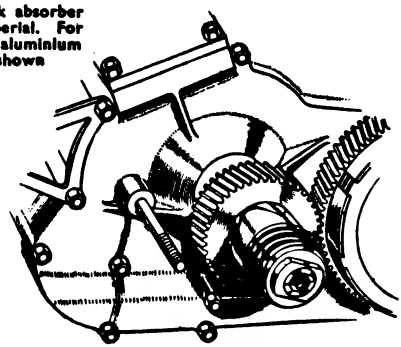


Fig. 72 : The engine-shaft shock absorber on the "Unidyno" New Imperial. For the sake of clearness, the aluminium primary drive cover is not shown

simplest type of gear box—the plain two-speed, is grasped, no difficulty will be experienced in understanding the general principles of the four-speed type of box, such as is to be found on the majority of motor cycles to-day.

Fig. 73 shows a very simple two-speed gear box in diagrammatic form. On the left are the two chain wheels, or sprockets. The one shown white, the big sprocket, is the clutch sprocket and in a normal gear box would incorporate the clutch. This is rigidly fixed to the gear box mainshaft, which, as will be seen, runs right across the gear box. In the middle of the shaft is what is termed a double dog clutch. This has dogs, which are really big teeth, on each side, and can be moved either to left or right along the shaft. When it is moved to the left the left-hand dogs engage with similar teeth on the big cog-wheel that is shown in black.

How the Dog Clutch Functions

While the double dog clutch can be moved towards either the left or the right of the mainshaft (by means of a fork that runs in the slot in the dog clutch) there are square-shaped protruding portions on the shaft (splines) which mate with slots cut on the inside of the dog clutch ; thus the dog clutch rotates with the mainshaft ; it is fixed to it except that it can be moved endways by the forked member—the gear selector fork.

It will be noticed that the two gear pinions on the mainshaft are merely fitted round the shaft ; they are not fixed to it in any way. In the case of the other shaft—the layshaft—however, the two pinions are part and parcel

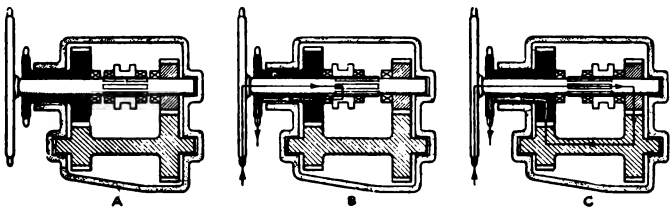


Fig. 73 : A simple two-speed gear box in diagrammatic form

of the shaft. They, therefore both turn at the same speed. It will also be seen that the pinions on the layshaft mesh with those on the upper shaft—the mainshaft.

If the double dog clutch is in the mid-position, as in Fig. 73 A, the white portion, when driven by the engine, revolves idly and drives nothing. This is the neutral position. But, if the dog clutch is moved to the right, as in Fig. 73 C, the dogs engage with those on the pinion on the right and this pinion therefore revolves at the speed of the mainshaft—it has to do so, for it is locked to the shaft via the dog clutch.

Now let us turn the big white sprocket—imagine you are doing it by hand. As it is rotated, so we turn the pinion on the right, but this meshes with the pinion on the layshaft that lies immediately below. Therefore the layshaft turns, but at a lower speed than the mainshaft, because the pinion on the mainshaft is smaller than that on the layshaft. The left-hand pinion on the layshaft, in turn, causes the black pinion on the mainshaft to rotate and, therefore, the black sprocket, which drives the rear wheel.

The arrows show how the drive runs from the clutch sprocket, through the mainshaft and dog clutch to the right-hand mainshaft pinion and thence, through the layshaft, to the final driving sprocket.

It will be seen that in each case a small pinion is driving a larger pinion. Thus there are two gear reductions, and the rate at which the sprocket driving the rear wheel rotates relative to the speed of the clutch sprocket depends upon the size of the pinions. The smaller the driving

pinions in each case, and the larger the driven pinions, the greater will be the gear reduction.

If in each instance the driving pinions had twenty teeth and the driven pinions forty, the layshaft would rotate at half the speed of the mainshaft, and the sleeve pinion—the one shown black—would turn at only half the speed of the layshaft ; that is, a quarter the speed of the mainshaft. Therefore, the gear box would be giving a gear reduction of 4 to 1.

On touring machines the normal gear reduction in bottom gear is in the region of 3 to 1. This is only the reduction afforded by the gear box ; there is also the reduction from the engine to the gear box and from the gear box to the rear wheel, which, as already mentioned, usually gives a top gear ratio of about 5 to 1. If, over and above this, there is a reduction of 3 to 1 in the gear box itself, when bottom gear is engaged, the bottom gear ratio will be 15 to 1.

Top gear in all normal motor cycle gear boxes gives a direct drive. Let us consider what happens when the dog clutch is moved to the left so that its left-hand dogs engage with those on the sleeve pinion. Now let us again turn the clutch sprocket by hand. This causes the shaft to rotate and with it the dog clutch, but this latter is meshing with the sleeve pinion ; therefore the sleeve pinion and with it the sprocket that drives the rear wheel are rotating at the same speed as the clutch sprocket. The drive, as mentioned just now, is direct. The two sprockets are turning at exactly the same speed—top gear is engaged, and the layshaft and its pair of pinions are merely revolving idly and driving nothing.

If all this has been grasped, no difficulty will be experienced in understanding the more complicated types of gear box. Fig. 74 shows a

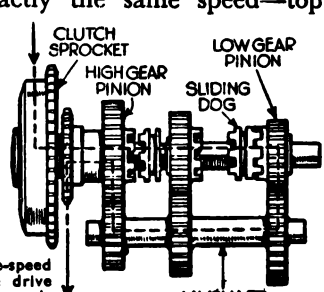


Fig. 74 ; A simple three-speed gear box showing the drive when bottom gear is engaged

simple type of three-speed gear box diagrammatically, and Fig. 75 a four-speed box.

Both hand gear changes and foot controls are available. In the former case there is usually a gear quadrant mounted alongside the offside of the petrol tank—a gear gate and hand lever with the position of the lever for the various gears marked on the gate. With a foot gear change there is generally merely a pedal protruding from the gear-box end cover and changing gear is effected by pressing the lever down or pulling it up with the foot.

Usually a little indicator is provided to enable the rider to check whether neutral has been engaged as, for instance, when the rider comes to a stand-still in traffic.

A Dry-Plate Clutch

Motor cycle clutches are generally of what is termed the "dry-plate" type. Fig. 76 illustrates a very simple clutch of this type with its control. D is the clutch sprocket driven by chain from the engine and faced on each side with friction material; A is the back plate, which is rigidly attached to the mainshaft of the gear box; B is one of a series of studs that are fixed to the back plate and

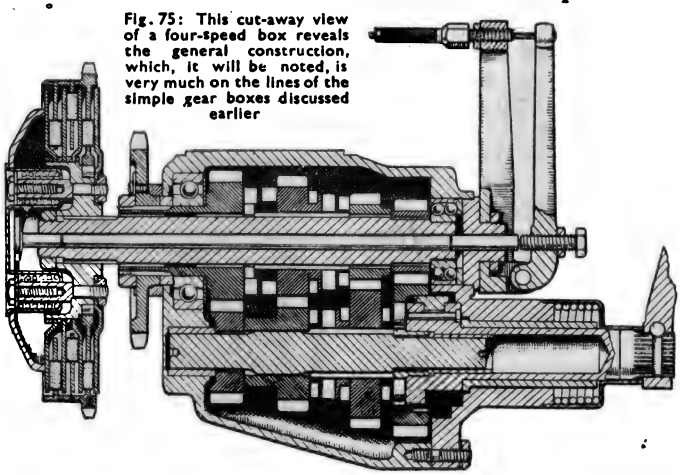


Fig. 75: This cut-away view of a four-speed box reveals the general construction, which, it will be noted, is very much on the lines of the simple gear boxes discussed earlier

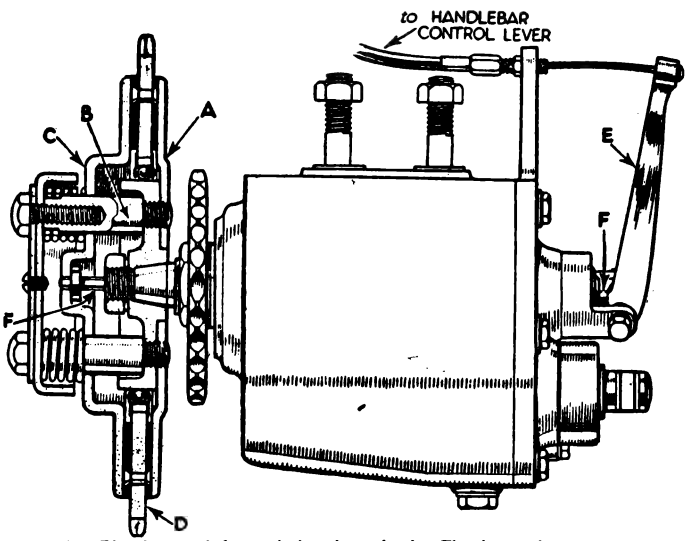


Fig. 76 : A straightforward dry-plate clutch. The lettered parts are explained in the text

pass through holes in the outer clutch plate C, and F is a steel rod that passes through the gear box mainshaft and presses on the outer clutch plate at one end and is operated by the clutch control lever at the other.

As illustrated the clutch is fully engaged. The springs around the studs B are pressing on the outer clutch plate and, because of the pressure and the friction material attached to the clutch sprocket, the inner and outer clutch plates and the sprocket are all turning as one. Therefore, if the engine is running, the clutch sprocket is driving the gear box.

Now let us assume that the handlebar clutch lever is operated. This causes the lever E to be pulled towards gear box and presses the clutch push rod inwards—which, in turn, compresses the clutch springs and relieves the pressure between the clutch plates. There is now no pressure to cause the plates to grip via the friction surfaces

and therefore the clutch sprocket (still assuming that the engine is running) revolves on the ball bearing provided for the purpose and the clutch plates remain stationary—no power is being transmitted to the gear box.

If the clutch lever be released gently, the outer plate will gradually start to press on the sprocket—the clutch will begin to "bite" and, if a gear is engaged, the machine will get under way.

Of course, the clutch described is of the simplest possible type. This has been done on purpose in order that the general principles may be grasped without difficulty. Nevertheless, in actual practice it will be found that almost every clutch fitted to motor cycles is of very similar design and more complicated only by reason of the fact that there are several pairs of plates.

Sometimes the friction material employed is cork in the form of inserts pressed into holes in the friction plates; more frequently in these days some form of asbestos material is employed.

CHAPTER 9

FRAMES AND FRONT FORKS

Frame Design and Construction : Springing Systems

THERE are two main types of motor cycle frame, namely, those which are made of pressed steel and those which are built from steel tubes. The latter type is the more common.

Originally the motor cycle frame was little more than a strengthened bicycle frame. Even to-day there are motor cycles on the road with frames that bear a close resemblance to the cycle frame. Fig. 77*a* shows one of the simplest types of modern motor cycle frame—the so-called diamond frame. In the drawing the various frame members are indicated by the names that are usually applied. It will be realized that the crank case forms the tie between the front down tube and the seat tube. This is not a particularly good practice because if the crank case flexes under a road shock it will be failing in its duty to the engine—which is to provide a rigid mounting for the crankshaft assembly.

Loss of rigidity means waste of power through friction and unnecessary wear. For these reasons certain of those manufacturers who employ frames on these lines link the seat tube and the front down tube with a pair of thick steel plates that run round the bottom of the crank case, thus relieving the latter of strain.

The joints between the various tubes are usually made by means of forged-steel or malleable cast-iron lugs, brazed to the tubes. Brazing is a form of hard soldering. The tubes, after having their ends cleaned, are fitted in the lugs and held in place by means of steel pins driven through the lugs and their respective tubes. Then the joints are heated to a bright red and molten brass is run into each of the joints. Borax is used as the

flux to prevent the formation of oxide and ensure that the brass takes proper hold of both the lug and the tube, thus making a perfect joint.

Sometimes what are known as pin-joints are employed. In this case the ends of the tubes are strengthened and, after being flattened and drilled, are bolted together. Occasionally the various members are joined by welding.

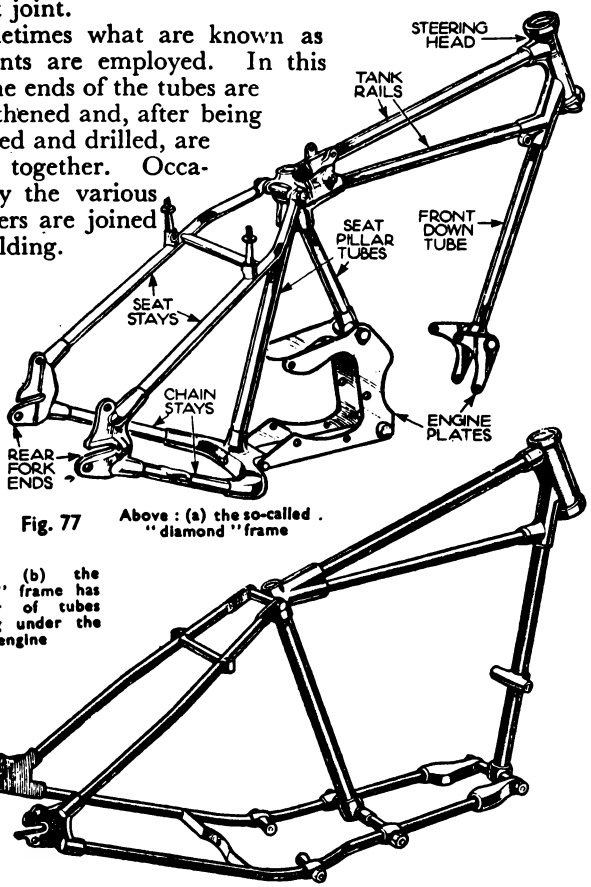


Fig. 77 Above : (a) the so-called "diamond" frame

Below, (b) the "loop" frame has a pair of tubes running under the engine

Brazing, however, is still the most usual method except in the case of pressed-steel frames, in which case designers

often adopt welding for some parts, while others they affix by means of bolts or rivets.

It will be realized that the simple diamond-type frame illustrated in Fig. 77*a* is not very rigid in a lateral direction. If one end could be fixed in a vice and the other pulled, it is probable that a considerable amount of " give " would be detectable. Whether a high degree of lateral rigidity is desirable or not is still a matter on which designers fail to agree. Obviously, the frame should be sufficiently rigid to ensure that, if chains form the transmission system, the sprockets are always maintained in correct alignment—otherwise there will be needless loss of power as well as unduly rapid wear.

However, the chief function of a frame, next to providing a suitable housing for the various components, is to ensure that the machine steers well both on the straight and round corners. It is on this steering question that opinions differ. One school of thought demands a fairly high degree of lateral rigidity, while the other prefers that the frame shall be able to flex. So many factors enter into this question of steering that it is next to impossible to say which school of thought is right, but lately there has certainly been a tendency towards greater rigidity and, it must be added, machines as a whole are steering better than ever. Nevertheless, it is easy to believe that frames can be too rigid—just as a sidecar chassis can be too rigid and, because of its rigidity, be liable to break when subjected to extreme conditions.

Fig. 77*b* shows another type of tubular frame. This is of the " loop " type, there being a pair of tubes running under the engine. The word " loop " is used even when the tubes do not actually run round the crank case in the form of a loop. Tubular frames have a single front tube or twin front down tubes, depending upon the particular design. The chain stays, too, are sometimes duplicated with a pair of tubes known as torque stays. Some machines have twin seat pillar tubes.

Very occasionally the steering head and the tank rail are made in one. In this case a sturdy forging or malleable iron casting is employed. Sometimes a combination of

pressed steel and tubular construction is used. It is impossible to state that one method of construction is best and the others wrong. The fact is that motor cycles in practice can be made to steer well more or less irrespective of the method of construction employed.

Pressed-steel frames vary widely in appearance, but the methods of ensuring stiffness are generally much the same. Usually the edges are turned over in the form of flanges

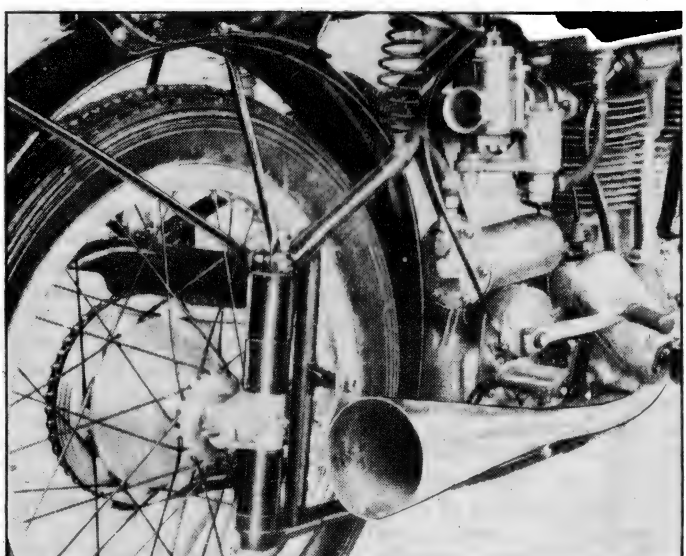


Fig. 78 : The Norton design of rear-wheel suspension is in the form of sprung plungers

and the frame is pressed in halves, joined together by various bearer bars and other cross members. Fig. 80 illustrates a frame of this type, while Fig. 81 illustrates in section the steering head of a frame of this type.

Some frames are provided with rear-wheel springing. Unquestionably a spring frame can effect a big improvement in both road-holding and comfort. It enables rough sections of road to be tackled without reduction in speed, and is a safety factor in that the rider is not thrown about

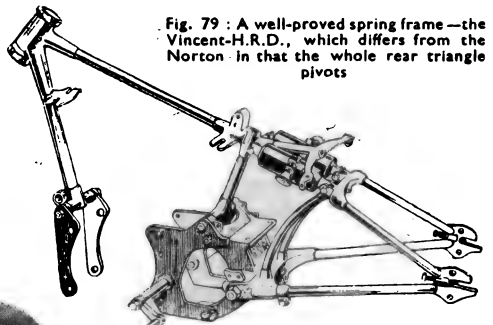


Fig. 79 : A well-proved spring frame—the Vincent-H.R.D., which differs from the Norton in that the whole rear triangle pivots

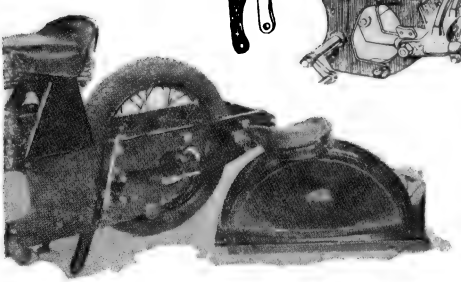
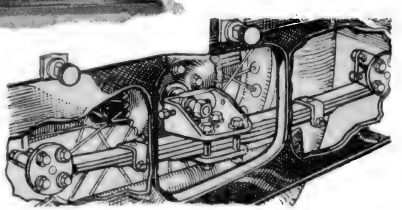


Fig. 80 : A clever pressed-steel frame—the Coventry Eagle "Pullman". Laminated rear springs (see below), provide the rear-wheel suspension



to any extent in the event of the machine striking an unexpected pothole.

A spring frame is, of course, more expensive to produce than that of the rigid type. It is because of this and the fact that the roads in Great Britain have such excellent surfaces that the spring frame is slow in becoming universal. Another reason is that it is a difficult matter to design a spring frame that is really neat. Nevertheless there is a number of neat yet extremely efficient spring frames on the road to-day.

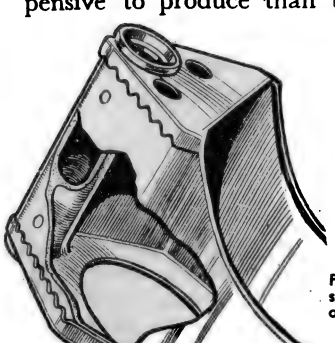


Fig. 81 : The steering head of a pressed-steel frame

In general terms it may be said that there are two main types of spring frame. There is the type in which the whole rear frame hinges immediately behind the gear box and operates against coil springs mounted beneath the saddle. In addition there are spring frames in which only the rear wheel moves, the wheel being mounted between springs built into each side of the rear frame members. Examples of each type are shown in the drawings. Actually, of course, there are many different designs. The most important item in regard to any layout is that the frame shall be reasonably rigid laterally—there must be no possibility of the rear wheel canting over to one side, say, on a bend or corner.

Theoretically the amount of unsprung weight should be as low as possible. It is also desirable in the case of a machine used with a pillion passenger that the passenger receives the benefit of the springing in addition to the rider. The question of fitting a sidecar to a spring-framed machine seldom presents any great difficulty, even if the sidecar has a rigid wheel. Usually it is only a case of employing special connections between the chassis and the machine—connections that can almost invariably be obtained from the makers of the particular chassis. With the type of spring frame in which only the rear wheel is sprung, fitting a sidecar is as simple as attaching one to a mount with a rigid frame.

Both tubes and steel pressings are used for front fork blades, but with only a very few exceptions the method of springing employed has become standardized, namely, the adoption of a single compression spring mounted centrally.

A Single-Compression-Spring Design

Fig. 83 shows a typical front fork of the single-compression-spring type. The bearing surfaces, it will be noticed, are provided with nipples ; these, of course, are for the application of a ram-type grease gun so that grease may be forced into the bearings. The spindles or steel rods that join the fork links are arranged to run either directly in the fork housings or in bushes mounted within the housings. The use of bushes is preferable because when wear takes place it will only be necessary to fit new bushes and

new spindles and not new forks. After this remark it is hardly necessary to point out to the novice that he should take particular care to keep his fork spindles properly lubricated.

It has been proved fairly conclusively that the front forks should have a long movement and preferably some form of damper that is progressive in action. Normal friction-type dampers such as illustrated in Fig. 84, if they have to be used tight, cause an undesirable amount of initial solid friction ; consequently a fair-sized shock is needed to deflect the forks at all and any shock that just

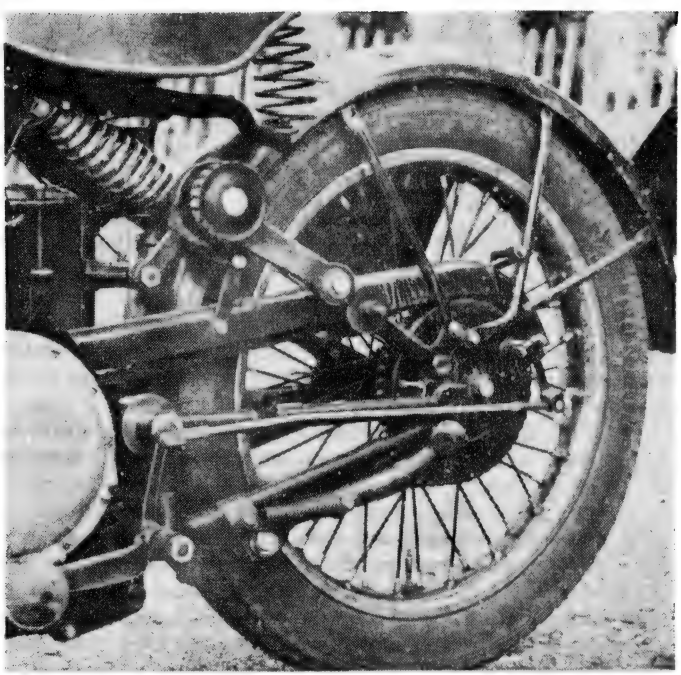


Fig. 82 : The hand-adjustable damper of this New Imperial spring frame model will be noticed

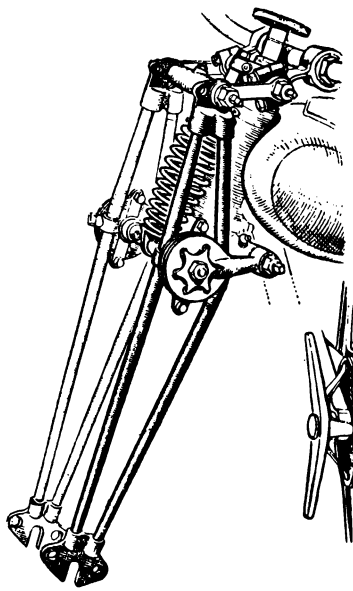
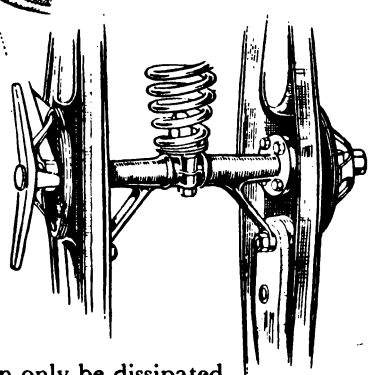


Fig. 83 : A typical front fork of the single-compression spring type ; the bearing surfaces have nipples for greasing, which is an important point of maintenance

Fig. 84 (below) : Friction-type fork dampers should be adjusted by trial-and-error



fails to deflect the forks can only be dissipated in the tyre and/or by throwing the machine and rider upwards—in other words, both the machine and rider receive a minor blow and it is some time before the front tyre is in proper contact with the road again.

Friction dampers are normally provided with either a handwheel or levers for adjustment purposes. Generally it is best to adjust them so that the amount of damping is as light as possible having regard to the road conditions. If the front wheel is too lively and the forks tend to "bottom" or clash on their return, then obviously more damping is needed. As far as possible the amount of damping should be varied to suit the road conditions, though in the case of front forks which have sensibly been provided with a long range of movement and a soft action it is usually found that little or no damping is needed. In some cases tension springs, with special linkage to provide

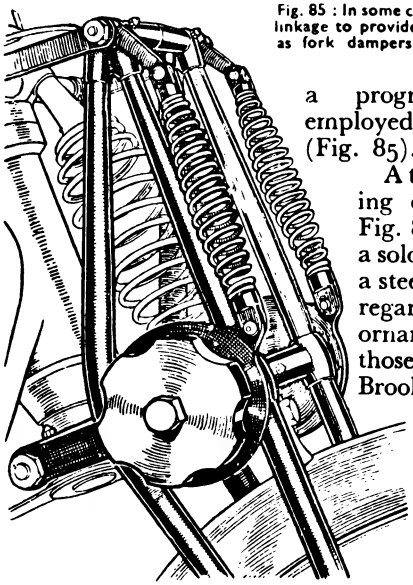


Fig. 85 : In some cases tension springs, with special linkage to provide a progressive action, are used as fork dampers. This is the Norton design

a progressive action, are employed as fork dampers (Fig. 85).

A typical design of steering damper is shown in Fig. 86. If the machine is a solo and steers really well a steering damper may be regarded chiefly as an ornament by all except those who compete at Brooklands or in high-speed road races. On normal work the damper, instead of helping the steering, tends to spoil it. At the most it should be barely biting. Care should be taken to see that the fixed or anchorage plate of the damper is in proper alignment with the other plates and that any screw holding the anchorage arm is tight and unworn. Malalignment can cause a solo to roll in a disconcerting fashion, while backlash at the anchorage makes the steering jerky and with a tendency towards wobbling.

With a sidecar outfit the position as regards the adjustment of the steering damper is different. In this case fairly heavy damping is desirable, and often nearly essential, and the plan is to damp down the steering until the front wheel neither wanders nor wobbles—in other words, make the steering heavy without it being so stiff that steering the outfit is an effort.

Before the subject of frames and forks is left, a few words are needed regarding that link between frame and forks, the steering head bearings. Three types of head bearings are in common use. These are the cup type, the cup-and-

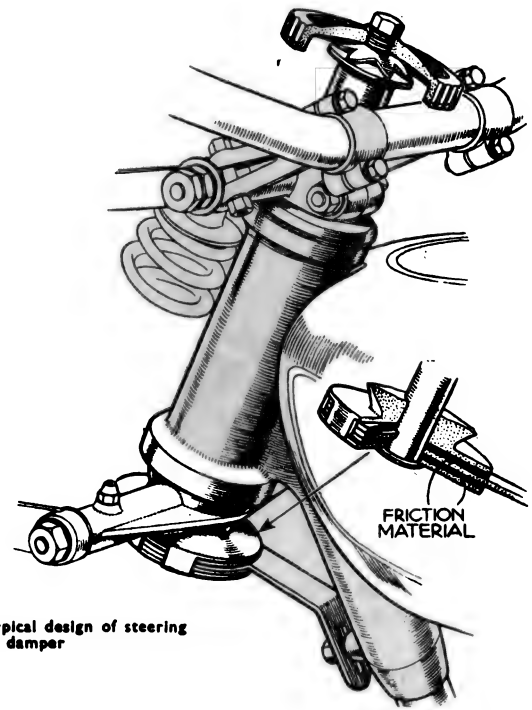


Fig. 86 : A typical design of steering damper

cone, and the taper roller. The last two types are shown on the next page in connection with wheel bearings. Experience seems to show that it does not matter very much which type is fitted so long as the particular bearings are of ample dimensions and they are never over-tightened, either during the erection of the machine at the makers, or later on, when the time comes to adjust up the bearings. Correct adjustment is all important ; it is discussed in detail in Chapter 26.

CHAPTER 10

WHEEL DETAILS

Bearings : Rims and Tyres : Brakes

THE bearings employed for the wheels of a motor cycle are very similar to those utilized in the steering head. There are three main types : first, there is the taper roller bearing ; secondly, there is the cup-and-cone type, thirdly, the journal type of ball bearing. Each of these types is illustrated in Figs. 87 to 89.

The advantage of the journal-type ball race is that it does not require any adjustment — in fact, it cannot be adjusted and when eventually wear does take place it is merely a matter of fitting new bearings,

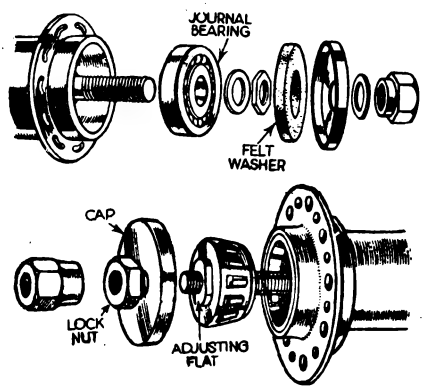
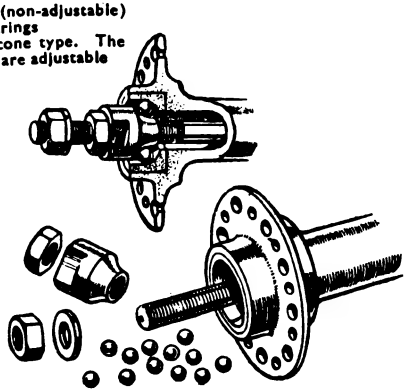


Fig. 87 (top) : Journal bearings (non-adjustable)
Fig. 88 (middle) : Taper roller bearings
Fig. 89 (bottom) : The cup-and-cone type. The bearings shown in Figs. 88 and 89 are adjustable



which is a simple, straightforward sort of job. Assuming that these bearings are of ample dimensions—which is a matter for the designer, of course—and are properly protected from the ingress of mud and water, they will give trouble-free service for as many as fifty thousand miles—frequently an even greater mileage.

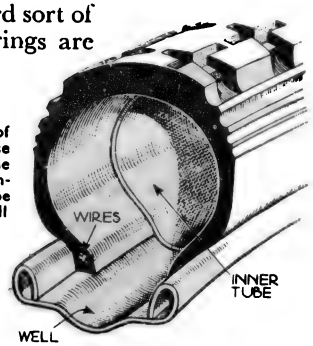


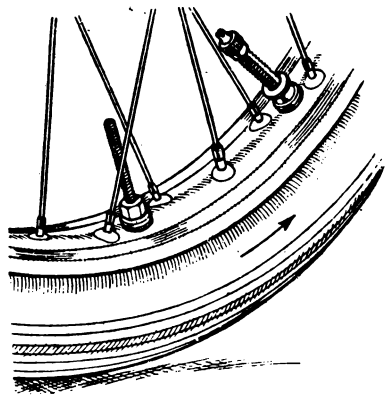
Fig. 90 : Section of a standard well-base rim, and tyre, as the latter appears fully inflated. A rubber tape runs round the well

Protection is all important with any form of ball or roller bearing, and the grease that is employed in the hub of a wheel is not so much for the lubrication of the bearings—for ball and roller bearings need little in the way of lubrication—as for the protection of the balls and races.

In all probability the most frequent cause of wheel bearing trouble is incorrect adjustment. The fact is not generally realized that it is possible to spin a wheel even when the bearings have been over-tightened to such an extent that there is a ton or more end pressure on the bearings. Never should the bearings be adjusted even a shade too tight, which means that very great care is necessary in the actual process of adjustment. However, this is a matter that is discussed in detail in Chapter 26, so after pointing out that with taper roller bearings it is essential to leave just a trace of slackness (equal to about $\frac{1}{64}$ in. side-play at the wheel rim), we will pass on to questions of tyres and brakes.

Well-base rims and wire wheels are universal on the motor cycles of to-day. Fig. 90 illustrates the section of a standard well-base rim and its appropriate tyre. The inner tube is shown extended in the form it takes when fully inflated. It will be noticed that each wall of the outer cover incorporates a wire close to its base. The idea of these wires, which are, of course, more or less inextensible, is to prevent the cover leaving the rim of its

Fig. 91: The position of the security bolt relative to the tyre valve



own accord in the event of the inner tube becoming deflated.

The reason for the well in the rim is to enable the cover to be removed—an easy task if the instructions given in Chapter 29 are followed in detail. A rubber rim tape is fitted as standard round the base of the well; this is only to protect the inner tube from chafing on the heads of the spoke nipples. In some racing-type machines the rim tape is replaced by what is termed a well-filler. It is really a very thick form of rim tape and is employed on very fast machines as an additional safety measure. In cases where this scheme is adopted it is necessary to remove the well-filler before any attempt is made to detach the outer cover.

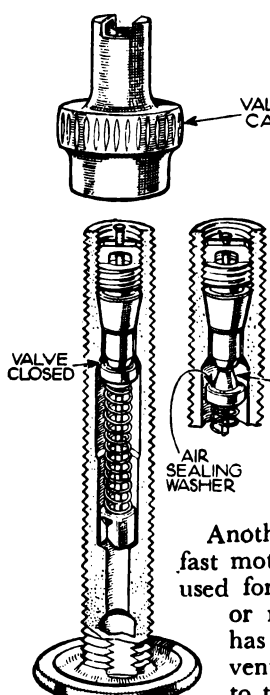


Fig. 92: The well-known Schrader valve cut open. The valve cap (not to scale) is provided with prongs which, when the cap is reversed, form a spanner to unscrew the valve inside

Another safety measure employed on very fast motor cycles and also on motor cycles used for trials riding is the fitting of one or more security bolts (Fig. 91). It has to be realized that a tyre is prevented from moving round in relation to the rim solely by the air pressure in

the inner tube—in other words, unless a security bolt is fitted, a tyre is "inflation held". The reason why security bolts are employed by trials riders is that very low tyre pressures are used for muddy, slippery trials sections in order that riders may obtain the maximum possible tyre grip. Without security bolts the tyres would in many cases creep round their rims and pull the tyre valve out of the inner tube. Incidentally, Fig. 91 shows the correct position for the security bolt in relation to the valve.

The Schrader type of tyre valve is now standard on all motor cycles, including those used for racing (Fig. 92). The great advantage of this type of valve in comparison with the cycle or Wood's type is that it enables the user

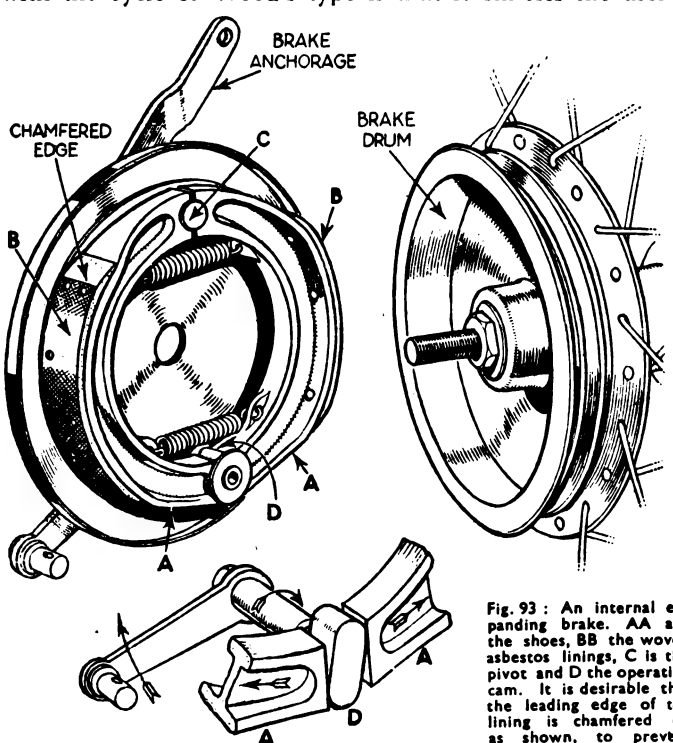


Fig. 93 : An internal expanding brake. AA are the shoes, BB the woven asbestos linings, C is the pivot and D the operating cam. It is desirable that the leading edge of the lining is chamfered off as shown, to prevent "snatch," and fierceness

to test his tyre pressures by means of a tyre pressure gauge.

Internal-expanding brakes are universal on modern motor cycles. A typical brake of this type is shown in Fig. 93. The shoes (A) are generally of aluminium and the brake linings (B), which are riveted to them, are of woven asbestos. The two shoes are linked together by springs and the pivot (C). D is the operating cam.

Picture the cam being turned through a few degrees. Obviously the ends of the brake shoes will be forced apart and the linings will press upon the brake drum, which is either part and parcel of the wheel hub or bolted to it. The more the cam is turned the greater will be the pressure between the brake shoes and the drum and, since the brake shoes are carried on a plate fixed to the front forks or rear frame members as the case may be, the greater will be the retarding effect upon the wheel. That, briefly, is the manner in which an internal-expanding brake functions. There is, as will be seen in Fig. 93, a lever attached to the spindle of the cam—the brake cam lever—and this is linked to the brake pedal in the case of the rear brake and a lever on the handlebars in the case of the front brake. Occasionally it is found that the brakes are coupled together. The brake pedal operates both the front and rear brakes, while the front brake can as a rule also be applied separately, or have additional pressure applied to it, by means of the control on the handlebars.

A little earlier it was mentioned that sometimes the brake drum is attached to the hub instead of being actually part of it. The chief reason for this practice is to enable the maker of the machine to fit a drum of special iron that has been found by experiment to be outstandingly good as regards both freedom from wear and distortion. Another advantage of this arrangement is that should a drum become scored or otherwise more or less worn out, it alone need be replaced—there is no necessity for a complete new hub plus rebuilding the wheel.

In practice modern brakes are extraordinarily free from trouble. Even the linings, which are both inexpensive and easy to replace, generally last for twenty thousand miles and more.

CHAPTER II

CHOOSING A MACHINE

The Selection : Solos, Sidecars and Three-Wheelers

ASK any motor cyclist for details of his first run—of the first time he got in the saddle of a motor cycle ; his eyes will kindle as his mind goes back to that never-to-be-forgotten thrill when he found himself under way in charge, as it were, of some living yet, even in his clumsy hands, controllable thing.

Nearly as thrilling in all probability were the events that led up to that ride ; first, with enough money saved up, deciding what sort of machine to have ; then, whether it should be new or second-hand ; and, finally, best of all, buying the machine.

Usually those twin questions of what to buy and how to buy it form a bit of a puzzle. During the period of saving up, sometimes extending over years, these matters have been considered from this angle and that ; the choice *must* be right, yet one friend advises a 150 c.c. Badger and another a 490 c.c. overhead-valve Otter ; one counsels the purchase of a second-hand mount because of the possibility of the novice, through his inexperience, knocking a new machine about and spoiling its appearance and performance—all of which seems to make the final decision extremely difficult.

Happily, there are no new motor cycles on the British market which the expert, hand on heart, could not describe as good motor cycles. Some are better than others, and speaking generally, the higher the price of a given size and type the better the machine.

There is one pretty sound method of deciding whether a particular make is better than another, and that is by comparing the prices they fetch second-hand as shown

by the classified advertisements in *The Motor Cycle*. This gives a useful clue to their relative merits in the eyes of the world at large, but it should be remembered that, usually, a comparatively unknown machine, even if eminently sound, does not fetch as much second-hand as a similar mount from a really famous factory.

Whether a new or second-hand mount should be purchased depends very largely on the sum of money available. If the use to which the machine will be put demands a 500 c.c. model, and all that can be afforded in the way of a new motor cycle is one of 250 c.c., then a really good second-hand should be bought. But where the prospective rider can afford a suitable new machine, then usually the best advice is to leave second-hands alone. No second-hand, barring the odd exception, can be as pleasurable as a brand-new bus, and the chances of the novice of average sense damaging a new machine are minute in these days of perfected oiling systems and of motor cycles that are practically skidproof.

Two Points to Remember

Two points should be borne in mind when the purchase of a second-hand machine is contemplated. First, either the services of a knowledgeable friend, who will "vet" the machine, should be enlisted, or the purchaser should place himself in the hands of a first-class agent, telling him his needs. No decent agent—and there are few otherwise—will let the novice down. As a matter of interest, if a novice explains his needs to an agent, and relying upon the skill and knowledge of that agent buys the machine recommended, then, should the mount prove unsuitable for the purpose he has stated, he is legally entitled to have the machine made suitable. This, although usually quite unnecessary, is a safeguard, but naturally the novice must have a witness present during any conversations if he is to prove his case.

However, to revert to the main topic of this chapter, namely, what to buy, the first thing the prospective purchaser should ask himself is the use to which the machine will be subject. Is the idea to have a mount

just for running about town or in and around the local village—to use the machine for short-distance work in a flat part of the country? Or is the intention to combine runabout work with touring in the Scottish Highlands, in the Lake District, in Devon, and other parts where hills are hills? Will the machine be used solo or sidecar? If solo, is the idea "solo and single" or the carrying of a pillion passenger?

These, and a host of other questions, the novice should ask himself until he is quite sure as to the performance he desires. Just one little interpolation here: do not run away with the impression that you will not want a reasonable turn of speed; if, when you have become thoroughly acquainted with motor cycling, you are not bitten occasionally with the speed urge—well, you aren't normal. Often novices decide that a 100 c.c. or 150 c.c. two-stroke will fulfil their needs; they are probably quite right at first, but a little later on they go in for something larger, heavier and faster. This, as a matter of fact, is a very good scheme, for the small lightweight is a most excellent stepping-stone for the soloist. It is low in weight, simple to handle, and nowadays essentially reliable.

Confidence from the Lightweight

The confidence that results from riding a lightweight and the knowledge gained in the matter of manhandling the machine, means that when the time comes for a change to a bigger mount everything is plain sailing. Weight actually is a nuisance only when the machine is being put on its stand or wheeled about; even in the latter instance it causes little trouble if the owner sits astride his mount and paddles it about. Where weight is an advantage is that it usually improves the road-holding and therefore the comfort of the rider.

Except single-speed 100 c.c. machines of the motorised bicycle type—autocycles, in other words—all motor cycles produced to-day will climb solo any hill likely to be encountered in Great Britain during a normal tour. The difference between a small machine and a large one is not that the former will climb with any less certainty,

but that it will not climb so fast nor be so comfortable. The latter runs on higher gear ratios and is therefore more effortless.

If the new machine is to be a lightweight, there is the vexed question of two-stroke or four-stroke. Some do not like the two-stroke because of its tendency to run irregularly at low speeds on the level, or downhill and when the machine is idling ; tens of thousands, however, plump wholeheartedly for this type on account of its high performance when made with small cylinder dimensions, of its wonderful simplicity, of its pulling power at low speeds under adverse conditions, and of its utter reliability. It is largely a matter of personal choice, for from either type first-class service can be anticipated.

What Type and Size?

Having cross-questioned himself as to his needs, the novice should have little difficulty in deciding from an outline of the capabilities of the various mounts the particular type and size of machine that should suit him best. So, rather than endeavour to foist a particular type on to each and every kind of Mr., Mrs., and Miss Novice, it is proposed to indicate the chief points of the many classes and leave it to the said lady or gentleman to decide where he or she comes in.

First, there are the 98 c.c. two-strokes, of which the vast majority are autocycles. These are largely runabouts, with, as their main mission, the making of short trips in flattish country. They are simple, extremely reliable and capable of some 140 miles to the gallon and of climbing, without any pedal assistance, hills of about 1 in 7. For serious touring or runabout work under hilly conditions there are the gear-box equipped 98 to 150 c.c. models. These will climb main-road hills as steep as 1 in 5.

With a 125 or 150 c.c. engine, 35 to 40 m.p.h. is usual, and about 45 m.p.h. with the sports 150, which, while more lively, is usually not quite so good at slogging away in top gear. The fuel consumption at a fairly steady

speed of 25 to 28 m.p.h. usually works out at 120, and often considerably more, miles to the gallon; in other words, at about five miles a penny. These machines *can* be used for pillion riding, but, in the opinion of most people, it is asking rather too much from them. Electric lighting is fitted as standard to all present-day motor cycles and autocycles.

The smallest-sized machine used in large numbers for carrying a pillion passenger is the 250 c.c. mount. In this class we have two-strokes, side-valve four-strokes, and overhead-valve four-strokes. It is not proposed to touch upon the two-stroke *v.* four-stroke controversy again, but mention must be made of the advantages and disadvantages of the various types of four-stroke.

Briefly, for freedom from adjustment and simplicity in maintenance, the side-valve engine has the advantage, but, speaking generally of standard as opposed to sports units, the overhead-valve engine is slightly more economical in fuel consumption, faster on hills and on the level, more lively, and requires decarbonising less frequently. From this it might be imagined that the o.h.v. unit is preferable, and often this is the case, but for what may be termed hack work the simple side-valve, especially in a novice's hands, takes a lot of beating.

Overhead or Side Valves ?

Far too many people spend the extra demanded for an overhead-valve machine, because the o.h.v. engine is the thing, when a side-valve, with its simplicity and ease of engine maintenance, would suit them better. However, if the decision is to buy an overhead-valve machine, it should be borne in mind that there are roughly two types: semi-sports and super-sports, the latter being high-compression machines, often little removed from the racing mount.

About 50 m.p.h. is the maximum speed of the side-valves and two-strokes of 250 c.c., and anything from 50 to 70 m.p.h. for the o.h.v. mounts according to their type. Fuel consumption at 25 m.p.h. is roughly 110 m.p.g.

The same sort of classification is applicable to the 350 c.c. class, but here we have the smallest size normally employed for sidecar work. Much the same performance may be expected, but, of course, there is a little more speed and power and a rather higher fuel consumption, say, 100 m.p.g. at 25–30 m.p.h. When a sidecar is used, the fuel consumption naturally rises, usually to 75–80 m.p.g., while the maximum for a normal o.h.v. drops from about 60 m.p.h. to 45–48.

In this class twin-cylinder machines have been produced which raises the subject of multi-cylinders *v.* singles. Speaking briefly, yet with fair accuracy, the multi starts more easily, does not need decarbonising so frequently, and has greater flexibility and better acceleration. Against these advantages must be set the two facts that there are more working parts—therefore less simplicity—and that routine engine overhauls, when they do become necessary, usually take rather longer.

Unquestionably, the most popular size for sidecar work is the five-hundred, which, whether side-valve or overhead-valve, will tour anywhere with a passenger and luggage. Again, of course, with the larger engine size the maximum and cruising speeds and the fuel consumption all go up.

Side-valve Five-hundreds

Side-valve machines of 500 c.c., however, are seldom very fast, and it is unusual to get much more than a mile a minute solo with full electrical equipment. Speed with these is not the main point; their chief features are simplicity, retention of tune, and robust construction. Solo, their fuel consumption is normally about 80 m.p.g., and sidecar 65 m.p.g., while the speeds that can be maintained respectively are around 50 and 40 m.p.h.

With the semi-sports type of overhead-valve five-hundred, about 8 m.p.h. can be added to these speeds, the fuel consumption being, if anything, rather lower. The one remaining class, comprising the super-sports mounts with their ultra-high efficiency, is rather beyond the scope of this chapter, which aims at being a guide to

the novice. If his thoughts lie in this direction then he is probably a keen motor-cyclist-on-paper already.

Next comes the 750 c.c. class, which consists of 600 c.c. singles, 600 c.c. twins—four-strokes and two-strokes—600 c.c. fours and 750 c.c. twins. Here we have a still larger reserve of power and machines of even greater stamina. With a few notable exceptions, motor cycles of these sizes are used largely for sidecar work.

Last, but not least, among two-wheelers are the big twins and fours of 1,000 c.c., or thereabouts. A few people ride these 450 lb. heavyweights solo, for they enjoy the effortless way in which the big engines do their work, but as a rule such mounts are used for heavy-duty sidecar work, for which they offer the height of luxury.

Finally, there is that fascinating vehicle, the three-wheeled runabout, which offers motor cycle performance and car weather protection at a tax of only £5 a year. There are three-wheelers of many types—side-valves and overhead-valve twins, both air-cooled and water-cooled, and water-cooled fours—with speed capabilities from 50 m.p.h. in the case of the cheapest, to over 70 m.p.h. with the super-sports, the dearest. About 50 m.p.g. is the rule at a steady speed of 30 to 35 m.p.h.

Three-wheelers in these days are fitted with reverse gears as standard, also with electric starters.

CHAPTER 12

BUYING A MACHINE

Hire-Purchase or by Cash: Selection of Machine.

THERE are two ways of paying for a machine, either new or second-hand. One is, of course, buying outright by cash or cheque, and the other is that of hire-purchase, as it is normally termed. Much might be written of the saving up previous to purchase by cash—many are the accounts of years of saving that reach *The Motor Cycle* in the course of a year. Little, however, need be said about this form of transaction except to point out the somewhat obvious fact that by this means the purchaser obviates the need for paying interest charges, which are naturally inseparable from the hire-purchase system.

One other point should perhaps be stressed—one that applies to all purchases. It is not always realised that the payment of a cash deposit on a particular machine binds the prospective purchaser; the agent is entitled to demand that the man concerned buys that machine and no other. Often an agent is prepared to release the prospective purchaser subject to his retaining the amount deposited—occasionally he will permit the deposit to be transferred to some other machine—but the legal position is that he is perfectly entitled to force the man in question to abide by his side of the bargain and complete the purchase of the mount on which the deposit was placed.

Under the so-called hire-purchase system the purchaser pays a deposit entitling him to the delivery of the machine and then has to pay a stipulated sum on a fixed date each month for a stated period, which may be twelve months or even eighteen. Throughout this period the

machine remains the property of the vendor—that is, the agent or the hire-purchase company as the case may be.

The purchaser is not entitled to sell the machine; it is not his property and to sell it is a criminal offence. When all the monthly payments have been completed, however, the purchaser has the option of buying the machine for a purely nominal sum, which may be a shilling, half-crown, or five shillings. Only when this final purchase sum is paid has the purchaser a title to the machine and can call it his property and therefore, if he so desires, sell it in order to obtain some other mount.

Hire-purchase Agreements

Before entering into any hire-purchase agreement or signing any forms the prospective purchaser should carefully read the clauses so that he is fully aware of the conditions to which he is binding himself. Once the agreement has been signed it is essential that each monthly payment is made on the stipulated date. Those entering into an agreement should assure themselves that they are quite certain to be able to keep up the payments month by month over the period that has been fixed.

The Guarantee

With current listed new machines there is normally a standard form of guarantee. This covers as a rule a period of six months from the date of purchase. In certain cases it is only operative on the purchaser filling in a form supplied with the machine and forwarding it to the maker concerned. It is as well, therefore, to enquire regarding the guarantee when making the purchase.

The standard guarantee covers the replacement of any part or parts that prove faulty; it does not cover the fitting of those parts or the replacements of parts that may have been damaged as the result of the trouble, nor, of course, are new parts provided in the case of misuse or failure through ordinary wear and tear. While these are the terms of the guarantee in a nutshell, manufacturers of standing are naturally zealous of their good

name and many of them go far beyond their legal obligations in order to help their customers in the event of trouble—always assuming that they are approached in a reasonable manner and do not gain the impression that the particular customer is endeavouring to "swing it" on them!

Buying Second-hand

In the course of a year many thousands of second-hand machines change hands, some from one private owner to another and others, the majority, via motor cycle dealers. In the latter case certain of the machines may be sold as "guaranteed second-hands" and carry a guarantee similar to that just mentioned but covering perhaps a month or three months. Often these guaranteed second-hands are overhauled in the vendor's workshop, or at least carefully tested by his staff.

Naturally such machines usually cost a little more than those which the dealer sells "just as received", and normally the scheme only applies to the more expensive mounts in his stock. In the case of a novice it is always as well to pay the extra and obtain a guaranteed second-hand from a first-class agent.

A Useful Point

Except where a machine is specifically stated to be guaranteed there is no warranty with the average second-hand machine. As with all normal purchases, that old legal maxim *caveat emptor*—"let the buyer beware"—applies. The only case where there is a guarantee is that in which, as already mentioned, the purchase is being made from one whose business is the sale of second-hand machines and the purchaser, relying on the skill and knowledge of the vendor, states the exact purpose for which he requires the machine and is supplied with a mount to fulfil that purpose. If, in these circumstances, the machine fails to fulfil the requirements and the purchaser can prove that he placed himself in the vendor's hands in the manner stated, he is entitled to have the machine put in such condition that it does fulfil the named purpose.

Of course, there is nothing like a personal examination of the machine it is proposed to buy. Determining whether it is a bargain or not implies a wide knowledge of motor cycles. Each individual must ask himself whether he really has that knowledge. If the answer is a definite " No ! " or a half-hearted " Yes ", then the obvious course is to enlist the services of one who is an expert, either a private individual or an official of one of the organisations.

Needless to say, if the expert who runs the rule over the selected machine is an official of one of the organisations there will be a fee to pay (and in certain cases it is necessary to join the association concerned as a member). It will be worth while in the case of a good man, since you will know whether the machine is likely to need expensive replacements or not. A new big-end bearing, new valve gear or regrinding the cylinder and fitting a new piston can make a machine that appears at first sight to be cheap a really expensive proposition.

Some General Points

There are one or two other points of a general nature which the prospective purchaser is well advised to keep in mind. First, those who have a particular make and model in mind should obtain the maker's spare parts list so that they may know how much it is likely to cost to put the mount that is being examined into first-class order.

Secondly, it is always as well not to spend right up to one's limit. Thirdly, there are certain components that on any second-hand machine can almost be counted upon to require either immediate or early replacement ; for instance, a new battery is nearly sure to be needed and quite likely one or more new chains.

Mere appearance should not be allowed to mislead the prospective purchaser. There are more bargains to be found with a rough-looking exterior than is generally realised. When a machine looks " rough " it is never priced anything like so high as the mount that appears smart, even though the " internals " of the latter may

be nothing like so good. In the motor cycle world there are many men who lavish all their spare time and much of their spare money on the mechanical side of their mounts, and begrudge expending even minutes on the—to them—less interesting tasks of cleaning, polishing and preserving.

Help from "The Motor Cycle"

Whatever happens the prospective purchaser should avoid being impatient. A good look round may save pounds. The best time to buy a second-hand machine is towards the end of the year or at the very beginning, for then prices are generally down at rock-bottom. Eastertime and the period between Easter and Whitsun are usually the most expensive.

In cases where the prospective purchaser lives a long way from the machine of his dreams, the independent experts of the various organisations can be friends indeed. Naturally one should not buy a machine on "spec" unless it is definitely agreed between the two parties that the mount is on sale or return. Either the machine should be examined by an expert, or use should be made of *The Motor Cycle* Deposit System, of which full particulars appear each week on the first page of the Classified Advertisements of *The Motor Cycle*.

Frequently members of *The Motor Cycle* Staff are approached by readers with requests that they should purchase second-hand machines on their—the readers'—behalf. While *The Motor Cycle* is always at the service of every reader in the matter of advice, as can be readily appreciated members of the Staff cannot carry out financial transactions on behalf of readers or examine machines.

Of course, one cannot expect a five-year-old machine at a quarter of the original price to be in brand-new condition. Those words "excellent condition" used in the description of a second-hand machine must be taken as meaning that the machine is in excellent condition having regard to its age, the price asked, and the fact that the machine is second-hand or, maybe, third- or fourth-hand.

Sometimes a purchaser wants a machine of a specified year, and in any case it is as well to be definite as to the year of manufacture, as the day will come no doubt when it is desired to sell the particular model and purchase something different. To find out the year it is only necessary to forward the frame and engine numbers to the makers, enclosing a stamped, addressed envelope, and asking them to advise you as to the year of manufacture.

CHAPTER 13

THE LAW*

Insurance, Licensing, and Driving Tests

BEFORE any machine is used on the public highway there must be in force a policy of insurance covering the risk of bodily injuries to third-parties. This is essential under the Road Traffic Act, and using a vehicle without such policy in force or allowing someone else to ride or drive uninsured is deemed to be a very serious offence.

Insuring a machine is quite straightforward. In the case of a new mount, the agent from whom it is being purchased will often see to the whole matter, including licensing the machine and painting the number plates. If the machine is being purchased under a hire-purchase agreement the insurance may be part and parcel of the agreement.

In all hire-purchase deals it is a condition that the machine shall be insured, generally for full comprehensive cover, that is, third-party, fire and theft risks and in respect of accidental damage to the machine.

If, however, the model is being bought for cash or, although there is a hire-purchase agreement, the rider has a free hand as regards the choice of his insurance company, the important thing is to select a company of repute—one of unquestioned standing as regards its finances and known to be fair and equitable in the settlement of claims.

Cheap insurance can be cheap at any price. If a particular company offers cover at rates considerably lower than the charges of other companies, it can only be that the particular company, if financially stable, runs

* Readers are reminded that, while the legal requirements quoted in this book are correct at the time of going to press, various new regulations have in recent years been introduced almost over-night. Full details of all such alterations are given in the columns of *The Motor Cycle*, to which reference should be made.'

its business more economically than the others ; perhaps, it is outstandingly efficient in its business methods, maybe its expenses as regards offices are small, or, perhaps, it is decidedly " careful " over the settlement of claims. It should not be imagined that the stability of one's insurance company is a matter of small consequence—it is most important. If the insurance company fails and there is a claim outstanding against one as a result of an accident, the liability is one's own and, should the sum be large, it may cripple one financially for life as well as leaving one with a deep sense of remorse at having caused injury and not being able to make retribution.

From the foregoing it will be gathered that every care must be taken over the actual selection of the insurance company. If you do not know of a suitable company, obtain the advice of a friend who is an expert in such matters, or drop a line to *The Motor Cycle*, who are always prepared to help with advice on any motor cycle matter ; those applying should, of course, enclose a stamped, addressed envelope in accordance with the rules appearing on the " Question and Replies " page each week.

The " Cover Note "

In the case of a new machine the insurance company will supply a cover note on receipt of the application with the engine and frame numbers filled in. This cover note lasts fourteen days, and is issued pending the registration and licensing of the new machine and the furnishing by the company of the insurance policy and insurance certificate. Having obtained the cover note the new owner can register and license the machine either by post or by visiting the licensing office himself, or the agent, if requested, will see to the whole matter.

Should the postal method be employed, a call should be paid to a local money order post office in order to obtain the address of the local motor licence authority and the necessary registration form (R.F. 1/2)—plus, in the case of anyone who has never held a driving licence, an application form for a provisional driving licence. Questions of driving licences will be discussed in detail

later on; for the moment we will confine ourselves to matters in connection with registration and licensing.

Having filled in the registration form carefully, send it together with the cover note, the agent's delivery note or receipt and the appropriate duty, in the form of postal order or cheque, to the licensing authority. The amount to be paid is set out on the registration form. Should you decide to cover the whole matter by a personal call, in which case the registration licence will be handed over the counter, you need either to have the form duly filled in or to complete a form when you reach the licensing office. You should be armed with details of the machine (the frame and engine numbers; the capacity of the engine in cubic centimetres), plus, of course, the cover note, the duty that is payable and the agent's delivery note or receipt.

Number Plates and Licence

It is all quite simple and straightforward. Once the licence and registration numbers have been obtained, advise the agent so that the number plates can be painted, and inform the insurance company of the registration number so that it can issue the necessary policy and insurance certificate. The licence disc must, of course, be fitted in a licence holder on the machine.

This holder must have a glass front and be waterproof. On a solo machine the licence holder may be fitted anywhere on the forward part of the machine facing towards the near side; in the case of a sidecar outfit it must be either on the left handlebar of the machine or on the near side of the sidecar "forward of the driving seat". The licence must be easily distinguishable from the near side of the vehicle.

Definite legal requirements are also laid down as to number plates. Front number plates must have the letters and figures 1¾ in. high, $\frac{5}{16}$ in. broad and occupying a total width of 1¼ in. except in the case of the figure "1" or the letter "I". There must be a quarter of an inch between letters and figures, and a margin of at least half an inch between the outside figure and number and the end

of the plate, and a quarter of an inch at the top and bottom. A space of one inch is required between the number and the index.

On the rear number plate all the figures and letters have to be 2½ in. high, ⅜ in. broad and occupying a total width of 1¾ in., except in the case of the figure " 1 " and the letter " I ". The space between adjoining figures and letters must be half an inch, and there must not be less than half an inch of margin between the nearest part of any letter or figure and the border of the plate. If the letters are placed above the numbers, there must be half an inch between the bottom of the letters and the top of the numbers. If, however, the letters and numbers are arranged across the plate the space between the last letter and the first number must be one inch.

All the above dimensions apply to solo and sidecar machines. Although three-wheelers are classed as motor cycles so long as they weigh under 8 cwt. unladen, there are special regulations as regards number plates. All figures and letters must be 3½ in. high, ⅝ in. broad and occupy a total width of 2½ in. except for the figure " 1 " and the letter " I ". The space between adjoining letters or figures must be half an inch, and there must not be less than half an inch of margin at the top and bottom of the place. Where the letters are arranged above the numbers the gap between the two rows must be three-quarters of an inch ; if arranged across it must be one and a half inches.

In all cases the numbers must be in white on a black plate. Cast aluminium plates are permissible if the plate is black and the numbers are polished. Numbers, however, must not be detachable. Those which are supplied loose for fixing on must be riveted in place.

Re-declaring a Second-hand

Where a second-hand machine is bought—one that has been registered already and has a current licence—the registration book must be obtained from the vendor, the name and address of the new owner filled in at the appropriate place in the book, and the book forwarded to the

licensing authority with whom the machine was last registered ; the name and address of the authority will be found inscribed in the book, which will come back to you via your own local licensing authority. When the time comes for a new licence to be taken out the machine will have to be redeclared on the R.F. 1/2 form mentioned earlier.

More About Insurance

In practice the formalities are quite simple—every one of them. So far we have only considered the question of insurance against third-party risks. The Law, as already stated, only requires insurance against the possibility of bodily injuries to third-parties ; it does not demand that the motorist or motor cyclist shall be insured against damage to the goods of those third-parties, *i.e.*, their cars, motor cycles or other property. Obviously, however, one is more likely to damage another vehicle than a person. Since the difference in cost between a policy that only covers the bare requirements of the Law and one that covers all third-party risks is only a matter of a few shillings, the sensible scheme—the one adopted universally—is to obtain, *as a minimum*, full third-party insurance.

The words "as a minimum" are italicised because there are two other forms of insurance cover of a more embracing nature. The first is a policy covering third-party risks, fire and theft, and the second is what is called a full comprehensive policy, which, as mentioned earlier, includes cover against accidental damage to one's machine. Which policy should be obtained depends both upon one's machine and upon one's financial position.

Compared with ordinary third-party cover, a full comprehensive policy is, of course, expensive, but it is desirable, assuming one is free agent in the matter, unless one is in such a position that one can look with equanimity to the possibility, unlikely though it be, of having the machine smashed up as a result of perhaps a moment's thoughtlessness.

Many people shoulder this risk themselves, particularly if the machine is a comparatively inexpensive one and

the possibility of it being out of use for a period while they save up for the cost of repairs is more or less unimportant.

This is a matter for each individual to decide for himself—a comment that also applies to the question as to whether a third-party, fire and theft policy shall be taken out instead of a plain third-party policy. In this case, however, the difference in cost, instead of being perhaps pounds, is generally only a matter of ten shillings. With a new machine or any mount on which a thief might cast covetous eyes, such a policy is obviously desirable.

In these days all solo motor cycle insurance policies permit the insured to carry a pillion passenger. This only means that the machine is covered against third-party risks (and other risks in the case of a policy of wider scope) while a pillion passenger is being carried. Your passenger is not in any way insured against any possible injuries to him or her. Nor does a full comprehensive policy cover personal injuries to the insured.

It is as well to have these points perfectly clear in one's mind, but the best advice of all that can be given is that the insured, instead of throwing the policy into a handy drawer immediately it is received, reads it through carefully clause by clause so that he fully understands each and every one of the conditions.

A Permanently-fitted Sidecar

Where a sidecar is permanently attached, insurance companies as a rule allow a big rebate in the insurance premium—a reduction that is often very useful indeed. It must, however, be clearly understood that those who have such policies should never in any circumstance use the machine on the road with the sidecar detached; to do so is to ride uninsured—which, as already pointed out, is looked upon as a most serious offence, involving the man concerned in disqualification from holding a driving licence.

Similarly if a machine be ever loaned to a friend it is essential to make quite sure that the owner will be insured against third-party risks and also holds a current driving licence covering the type of vehicle.

In the case of full comprehensive policies it is possible to effect a useful saving in the annual premium by agreeing to pay the first five pounds or two pounds ten shillings of each claim under the heading of accidental damage. This is a plan adopted by a number of motor cyclists. Full particulars will be found on the proposal form of the company of one's choice.

Before insurance is left and we pass on to matters concerning the driving test, a few other items must be mentioned. The first is that in the case of new riders and those under 21 years of age insurance companies generally require an increased premium or that the insured pays what is termed an " excess "—that is he pays the first five pounds or two pounds ten shillings of each claim—which sum in certain instances must be deposited with the insurance company at the time the policy is taken out.

" Loading " the Premium

Such excess or " loading " of the premium, as the case may be, is often applicable only to the first annual policy, assuming that during the period in question there is no claim.

A second point concerns the transfer of an insurance policy from one person to another, as is sometimes desired in cases where one private individual sells his machine direct to another. It has to be realized that an insurance policy is a contract between the insurance company and a particular individual.

There is no *right* to a transfer. In certain cases insurance companies are prepared to transfer policies, if the new owner is what is termed a " good risk ", but no one should " buy " an insurance policy with a machine without finding out whether the insurance company in question is prepared to transfer the policy, and, if so, on what terms.

One important reason why insurance premiums are not lower than they are is that some motor cyclists when involved in accidents fail to collect any evidence and even in certain cases omit to report the accident to their insurance companies until days—perhaps weeks—have passed. The result is that the insurance company can

only pay up. Given a number of such cases and up go the premiums—either that or the company decides that motor cycle insurance is not worth while. Please read your claim form straightway and do your part should you be unlucky enough to be involved in an accident.

Apart from all this, the Law requires that in any accident involving damage to any person, vehicle or animal (for the purposes of the Act any horse, cattle, ass, mule, sheep, pig, goat or dog) the driver stops and gives his name and address and such particulars as are specified in his insurance certificate to any person having reasonable grounds for requiring these details ; failing the giving of his name and address he must report the accident at a police station or to a police constable as soon as possible and in any case within 24 hours.

Now for points on the driving test. In peacetime, this, the carrying of " L " plates and the restrictions about to be mentioned are compulsory for all who have not held a British driving licence previous to April 1st, 1934. Those in this category must first obtain a provisional driving licence, which, on filling up the necessary form (obtainable at any local money order office) can be obtained over the counter at the local licensing office (price five shillings), or by post, assuming that the applicant is not suffering from any of the diseases prescribed on the form, eyesight which prevents him or her from reading a car number plate in a good light at twenty yards (with glasses, if worn) or from anything else which would prevent him or her controlling a vehicle properly.

This provisional licence lasts for three months ; it is a " learner's " licence and while it is in operation the owner of the licence must carry " L " plates (obtainable from any accessory firm) at the front and rear of the machine. In peace, " learner " motor cyclists, except those riding solo motor cycles or any vehicle not constructed or adapted to carry more than one person, must always be accompanied in or on the vehicle by an experienced driver—one who has held a licence, other than a provisional one, for at least two years or has passed a driving test. Up to our going to press the regulations are still

framed that it does not matter whether the experienced driver is a car man and not a motor cyclist or vice versa in the case of, say, a car. If a " learner " rider of a solo takes a pillion passenger, that passenger must be experienced in accordance with the foregoing definition. For the purpose of the driving test the various types of vehicle are split into classes. Group 1 comprises " heavy locomotive, light locomotive, motor tractor, heavy motor car, motor car or motor tricycle equipped with means for reversing ". Group 2 consists merely of " trolley vehicle ". Group 3, " motor bicycle (with or without sidecar) or tricycle not equipped with means for reversing ". Group 4, " track laying vehicle steered by its tracks ". Group 5, " invalid carriage ". Group 6, " mowing machine, agricultural tractor or vehicle controlled by pedestrian ".

The " learner " who passes the test on a vehicle in one group has to pass a further test if he wishes to drive a vehicle in another group. This point is important to motor cyclists since three-wheelers without a reversing gear come in the motor cycle group and those with a reverse gear in the car group.

There is no great difficulty about the driving test so far as motor cyclists are concerned and it is advisable that it should be taken just as soon as the rider feels competent at handling his mount. It can be taken any time within the three months that the provisional licence lasts, but if anyone fails in the test a minimum period of one month must elapse before a further test is taken. A fresh provisional licence can be obtained covering a further period of three months—one can obtain provisional licence after provisional licence, but each one costs the sum of five shillings.

The important things before the driving test is taken are to be sure that one is competent at handling one's mount (particularly that one changes gear without taking one's eyes off the road and can stop quickly in an emergency), and that one knows the Highway Code inside out. Various questions will be asked and one is expected to give the Highway Code answers, and in the case of hand signals, those that appear in the Code and no others. This latter

point needs stressing, since motor cyclists are very apt to give signals with their left hands, as, for instance, o indicate that they propose turning left, whereas the Code only takes cognisance of signals given with the right hand.

All signals, incidentally, should be given with true military precision. It is also important that those submitting themselves to the test know the exact meaning of the coloured-light traffic signals and the rules regarding right of way at pedestrian crossings. Actually the whole of the Code must be studied and learned in detail, which is all to the good, since practice of its provisions goes to make the roads safer and more pleasant for all.

As soon as the new rider feels competent he or she should obtain a driving test application form, if one was not provided at the time the provisional licence was issued —it can be obtained from any licensing authority—fill it in and forward it to the local supervising examiner, whose name and address will be found on the back of the form, together with 5s., which is the fee per test. In due course the applicant will be advised as to where and when he or she is to attend with machine for examination. In the case of solo motor cycles it often helps the examining authorities if the fact that the machine is a solo is mentioned at the time the form is forwarded. If desired, the examination can often be arranged outside normal working hours.

As a whole the examiners are kindly, " human " individuals and there is not the slightest reason for stage fright. The test is usually absolutely fair and simple—merely to determine whether you are able to handle your mount properly and have a thorough knowledge of the Highway Code.

If you pass you will be handed a certificate to this effect and, on forwarding this to your licensing authority with the necessary five shillings, will receive a " full " driving licence. The " L " plates may be removed from the front and rear of your machine as soon as the test has been passed. If you fail—well, the faults, whatever they are, must be corrected, and on the expiration of one month another test can be taken on payment of the further fee of 5s.

CHAPTER 14

THE FIRST RIDE

How the Controls are Manipulated

WHAT is the best method of making an initial acquaintance with the machine on the road? Perhaps the soundest way of learning is to go to the top of some gentle incline, getting the agent or a friend to ride the motor cycle there. Then, by free-wheeling down the hill with the gear in neutral, the beginner gets the feel of the machine and learns to find the brake pedal without having to look down for it. Once the novice, as a result of this run downhill, knows how to apply the brakes, he can try the machine under its own power.

Where no suitable hill is available this free-wheeling must, of course, be cut out, and the beginner has straightway to try the machine with the engine running. Obviously some quiet, traffic-free section of road should be chosen.

The first thing is to learn what the various controls are and how they work. Fig. 94 shows the arrangement of the controls on a fairly typical machine. On the right handlebar will be seen a grip; this, when twisted towards the rider, increases the supply of mixture to the engine, and twisting it away, or "shut", has the opposite effect; in other words, it is a twist-grip throttle control.

Usually there is a small handlebar lever mounted close to the inner end of the twist-grip. This is an air lever which within limits, controls the amount of air that is mixed with the petrol to form the explosive gas. As a rule, it should be closed, or nearly closed, for starting, and then fully opened by being pulled away from the handlebar when the engine has started.

On certain machines—generally two-strokes—this second control is an independent means of altering the effective size of the jet which admits the fuel. In this case the

probability is that, instead of twist-grip throttle control, a lever is provided.

In all cases where lever control of the throttle is standardised and there are two levers mounted one above the other, the lower lever is the throttle and the upper is the air or jet control.

The third control on the right handlebar is for the front brake. On the left handlebar will be found the clutch lever, which enables the rider to "disconnect" the engine power from the back wheel, and, on most machines, a lever for raising the exhaust valve (in the case of a four-stroke engine), or the compression release (should the engine be a two-stroke). This last control is used for starting purposes.

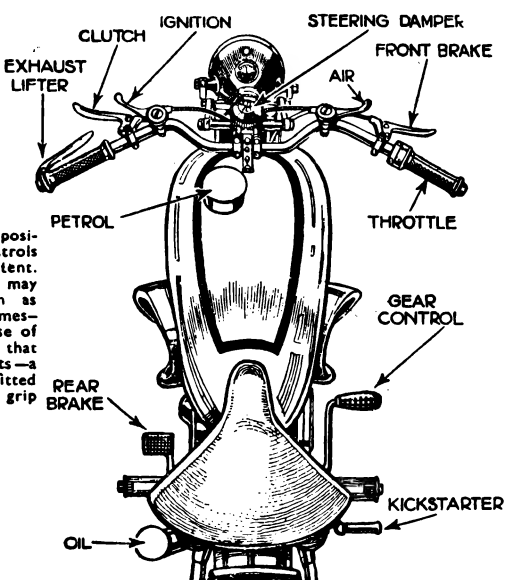


Fig. 94: The exact position of the controls varies to a certain extent. This control plan may however, be taken as fairly typical. Sometimes—especially in the case of old machines and in that of small lightweights—a lever throttle is fitted instead of a twist grip

One further lever will normally be found on the left handlebar—the ignition control, which advances and retards the spark.

Finally, there are the rear brake pedal and the gear lever, which may be of a type to be operated by hand or by foot.

Now, assuming that the gear lever is in neutral—that is, the position between bottom and second gears that allows the machine to be pushed along without the engine revolving—turn on the petrol and, if the engine is cold, press down the little tickler knob to be found on the top of the float chamber of the carburetter.

Press down the tickler until petrol just starts to exude from the instrument ; do not flood the carburetter so that petrol drips profusely. Then place the ignition control roughly in its mid-position. Shut, or nearly shut, the air control and open the throttle about a fifth of its total movement.

Next grasp the exhaust-valve lifter (or compression release), assuming one is fitted. Place a foot on the kick-starter and give the pedal two or three long, swinging pushes. As the pedal almost reaches the bottom of its travel on, say, the third kick, let go the exhaust-valve lifter. The engine should start. If it does not fire, the reason probably is that the valve lifter was dropped either too early or too late, or that the so-called " kick " was not of the swinging variety.

Once the engine is running, open the air lever as far as is possible consistent with the engine running properly. Then pull the clutch lever right up against the handlebar and, holding it there, gently move the gear lever into bottom-gear position. If the gears do not want to engage, ease the machine an inch or two forward, at the same time gently pulling on the lever. Now open the throttle a trifle and then gently—very gently—let in the clutch by releasing the lever. If the clutch is let in with a jerk, the engine may stop.

Once on the move, put your feet upon the footrests and control the machine's speed with the throttle. Try the effect of slightly opening it and then shutting off. To stop

the machine it is only necessary to close the throttle, apply the brakes and, just as the machine is coming to a standstill, raise the clutch.

Now comes the question of changing gear, which, in the case of a motor cycle, is simplicity itself. It is actually possible, with the majority of gear boxes, merely to raise the clutch lever and, without further ado, to pull the gear lever from one position to another. However, the proper method of changing gear is as follows: When changing from a low gear to a higher gear accelerate on the lower gear; then withdraw the clutch and at the same time close the throttle; next, with the clutch still out, move the gear lever gently but firmly into the required position. Then release the clutch gently, at the same time opening the throttle a little.

It is as easy as A B C, but the wisest plan is to learn to change gear with the machine on its stand—to change up and down, and down and up, until gear changing is so automatic that the rider never has to take his eyes off the road.

It has already been mentioned that in changing up, the throttle should be closed. When we come to change down the reverse is the case. The throttle should be left open. In other respects changing down is similar to changing up; that is, one raises the clutch, leaving the throttle open, and then with the clutch raised, moves the gear control into the required position; finally let in the clutch.

Only practice can ensure perfect judgment as to the speeds at which the gears should be changed. A golden rule, however, is never to allow the engine to thrash along on a high gear when it would run smoothly and lightly in a lower gear, and never let it rev its heart out on a low gear if, by changing up, it would be running perfectly happily and without effort.

The two brakes, assuming they have separate control, as is generally the case, should be used together. Wherever possible they should be applied gently at first, and then with gradually increasing pressure.

CHAPTER 15

THE SIDECAR

Choosing the Type : Comfort : Handling the Outfit

THE best piece of advice that can be given to anyone who is about to purchase a sidecar is that he should buy the best sidecar he can afford. When all is said and done a really smart, well-made and comfortable sidecar not only puts the finishing touch to the machine as a whole, but adds immeasurably to the enjoyment of the users.

What sidecar should be purchased is a matter of choice. There are all types available, from racing models with cut-down body sides to two-seater sunshine saloons which have a top that can be either folded or rolled back in fine weather.

It is always as well when purchasing a sidecar to arrange that your normal passenger tries the seating position. There is a world of difference between the degree of comfort provided by certain cheap types of sidecar and the more expensive models. In addition, the angle of the back rest, the length of the seat, and the amount of leg room can make all the difference to the passenger's comfort. Most of us vary as regards our size and consequently when it comes to a question of comfort, also regarding our needs.

Next to the question of seating comfort comes that of weather protection. Some passengers like to have a hood, while others prefer merely the protection of a good windscreen. In any case it is most important that the windscreen is arranged so that wind is not deflected off the driver's body straight on to the right-hand side of the passenger's face. Consequently, the screen should either have a side-screen protecting the passenger from this side-

draught, or be curved and brought back close to the passenger's face.

Some sidecars in these days are provided with adjustable footrests. These add almost immeasurably to the passenger's comfort, but if no footrest is fitted it is generally a simple matter to arrange a suitable hassock or even to fit a home-made rest of exactly the right proportions and in the right position to suit one's normal passenger. A point which is often overlooked is that it is desirable that the driver can obtain access to the sidecar locker without disturbing the passenger.

The driver no doubt will be more interested in chassis details than in the question of the comfort afforded by the body. The springing should, of course, be examined, particularly to see that there is no likelihood of the body tending to roll on corners.

Three or Four Connections ?

Some sidecars have three connections to the machine, others four. In the opinion of many sidecar men it is better to have only three connections since these will flex and therefore to some extent act as shock absorbers. It is a fact that if, within limits, a sidecar chassis can flex, there is next to no chance of it ever fracturing. On the other hand there are numerous sidecar drivers of experience who prefer to have the rigidity afforded by four connections. Chiefly it is a matter of personal preference.

In these days there is a number of quickly detachable sidecar chassis available. These can be invaluable in the case of a machine having to pass down a narrow entry to, say, a garage or shed in one's back garden. The prospective purchaser of one of these quickly detachable chassis should make sure that the design is such that wear is not likely to affect the rigidity or can at least be taken up quickly and easily.

All who are used to riding bicycles or solo motor cycles are liable to find a certain amount of difficulty in learning to drive a sidecar outfit, unless they have previously been informed of a very simple but effective tip. The learner should set off on his first ride with only one hand on the

handlebar—gently at first, of course. If he does this and uses the particular handlebar as if it were a tiller, he will find that in a very few yards he has become accustomed to the fact that one does not balance a sidecar machine but merely steers it by pulling and pushing on the handlebars.

The first run should be undertaken with someone, or, better still, ballast, in the sidecar, and it is as well to try one's apprentice hand at sidecar driving in as quiet a road as possible. By means of the tiller scheme confidence will soon be gained. Then comes the question of learning how best to negotiate bends and corners.

If the matter is thought over for a moment one realises that on a left-hand bend the wheels of a machine have to travel farther and consequently faster than the sidecar wheel. Thus, on a left-hand bend, the easiest possible steering and the neatest cornering result if, instead of closing the throttle as the bend is rounded, one gradually opens up.

In the case of a right-hand bend, naturally, one should close the throttle as the bend is rounded rather than open it. Very soon this practice of opening up on left-hand bends and shutting down or even braking slightly on right-hand bends becomes absolutely automatic.

Where a sidecar is high built or happens to be very light and unladen, or the chassis has a narrow track, there is, of course, a tendency for the sidecar to lift on left-hand bends, particularly if the machine is driven fast. It is always as well for the novice to find out where the limiting factor lies. If the sidecar tends to rise because a bend has been taken too fast, normally the trouble can be overcome by rapidly opening up the throttle. The thing, however, is to obtain the feel of the sidecar and thus at all times avoid the possibility of the sidecar wheel tending to rise.

It is also well worth while to determine the exact width of the sidecar by drawing in to a kerb and then getting off and noting the position of the sidecar wheel or mudguard relative to the kerb. If this is done a few times one is certain to have a very sure idea as to the width of the outfit and how much room it occupies on the road.

CHAPTER 16

DRIVING A THREE-WHEELER

Hints and Tips: the Methods to Adopt

TO a large degree driving a three-wheeler is very similar to handling a car. The controls are much the same and all modern three-wheelers have, of course, a steering wheel. Driving a three-wheeler is as simple as driving a car. In some respects it is safer, because of the large power/weight ratio, which means that the three-wheeler has that decisive acceleration so desirable under certain traffic conditions.

Naturally, it is not advisable to go gay with the acceleration, because no matter whether the three-wheeler has front or rear wheel drive it is possible, when the roads are very treacherous, to cause wheelspin and thus induce a skid. Normally no trouble is likely to occur in this direction unless it happens that a driving wheel is in a slippery tramline.

When learning to drive it is, of course, as well to be under the guidance of a friend who is accustomed to driving either three or four-wheelers. Actually, however, everything is almost as simple as can be, and anyone who has the ability to handle a two-wheeler will very soon be at home with a three-wheeler, particularly with certain types which have a motor cycle form of throttle on the steering wheel.

The first thing is, of course, to accustom oneself to the use of a steering wheel. Probably the best scheme is that suggested in connection with learning to ride a motor cycle, namely, that the machine should be driven to the top of some gentle hill free from traffic and that the new driver

should free-wheel down this hill, thus learning both to steer and to use the brakes.

Once the necessary experience has been obtained in these two directions the machine should be tried under power. At first the motor cyclist may experience slight difficulty in getting away smoothly from a standstill in view of the fact that he is almost certain to be unused to foot operation of the clutch and, in the case of some three-wheelers, a foot throttle—in other words, an accelerator. The method of getting away is, of course, precisely the same as that adopted in the case of a two-wheeler. It is simply a matter of letting in the clutch gently and increasing the throttle opening as the clutch takes up the drive. A little practice and a perfectly smooth getaway will become the rule.

Normally the gear box fitted to a three-wheeler is like the plain straight-forward type of box fitted to many cars. Gear changing is easy, but as a general rule a better change results if the driver adopts as his standard practice the type of gear change called " double-declutching ".

Double-Declutching

The procedure is simple and once learned will prove automatic. When changing up from, say, bottom to second, the foot is lifted off the accelerator at the same time as the clutch is depressed. Next, the gear lever is moved into neutral and the clutch let in momentarily. Finally, the clutch is disengaged again, the gear lever moved into second gear position and the clutch released—all this is accomplished with the throttle closed, except that as the clutch finally takes up the drive the accelerator may be depressed slightly in order to ensure perfect smoothness. The whole operation is accomplished far more rapidly, of course, than it takes to read these words.

Changing down is similar except that when the control is for the moment in the neutral position with the clutch engaged, the accelerator is depressed in order to increase the engine revs, and thus help to ensure that the pinions in the gear box are at the correct relative speeds for perfect engagement.

With the modern low-built three-wheeler only very wild cornering is likely to result in instability. There are, indeed, certain three-wheelers which will skid their wheels before there is any tendency for the inside wheel to "aviate". In the case of front-wheel-drive three-wheelers and those with two wheels at the rear, it is worth while making a practice of accelerating round bends rather than decelerating. The result of this is that, in effect, the three-wheeler takes itself round the bend.

The most important point as regards the brakes is to keep them in perfect adjustment with the front brake or brakes coming on before the rear wheel braking. As in the case of a two-wheeler, when one is braking to a standstill one should not disengage the clutch until the speed has been considerably reduced—say, to the point at which the transmission is about to feel snatchy.

The Engine as a Brake

By this means one is utilising the engine to assist the braking. If the front brakes are operated by a separate hand lever, it is as well to learn to use the hand lever so that the front brakes start to bite just before the rear brake (or brakes).

With a three-wheeler one has, of course, three wheel-tracks. Consequently, it is not so easy to avoid bumps. Potholes and broken bottles that are within the track can generally best be dodged by just missing them with the inside of the front offside wheel, or the rear offside wheel in the case of a three-wheeler with two wheels at the rear.

A similar scheme can be adopted in the case of tramlines, the offside wheel being so placed that it is just to the right of the nearside tramline. Many drivers of three-wheelers automatically pick out some point or feature on the bonnet or offside wing and use this as a sight so that without any concentration they find they can steer almost to a hair's breadth and thus keep out of tramlines, potholes, or other potential sources of trouble.

Numerous three-wheelers employ water-cooling. In such cases when the weather is very cold and there is the possibility of the water in the radiator and water jackets

freezing and thus causing fractures, it is as well to use a paraffin radiator lamp built on the lines of a miner's lamp, or to drain the water system or to add to the water one of the anti-freeze compounds that are obtainable from any of the large accessory firms.

If one adopts the practice of draining the radiator when there is likely to be frost, the radiator can be refilled with hot water, which will, of course, thin the oil in the engine and thus facilitate starting. Where this plan is not adopted it is as well to turn the engine over a few times by hand in order to free the engine. This saves the battery and the self-starter; and the battery, it must be remembered, is normally of fairly small capacity, while the engine, if a twin, is particularly hard on the self-starter equipment.

There is little else that need be said regarding three-wheelers, since the work involved in maintaining them is closely akin to that required in the case of a solo motor cycle—which is discussed later.

CHAPTER 17

CLOTHING

How to Defy the Weather: Scarves, Coats, Waders, Goggles and Headgear

OPINIONS differ as to the ideal kit for solo or sidecar work. Storm coats, Sidcots, competition coats, oil-skins, ponchos—they are all good. The best advice is that you buy the highest quality that you can afford, and that whatever design you decide upon you see that the actual garment chosen is amply large enough. This latter point is important, no matter whether you are buying a storm coat, waders, or a pair of gauntlet gloves. In the case of a coat plenty of overlap at the flaps is essential, and it should be on the big side so that there is room underneath for more than normal clothing, without any tightness and, therefore, without straining the seams.

With gloves you want looseness ; if gloves are tight they tend tc restrict the circulation—besides, you may wish to adopt the old dodge of wearing a pair of thin gloves underneath. Waders, too, should be fairly loose so that they are easy to put on and pull off, though not so sloppy that you cannot operate the foot change and brake pedal properly.

To-day there is a wide range of motor cycling coats. Some are smarter in appearance than others ; some are better made ; but experience proves that with each of the various designs it is possible to keep out practically anything in the way of weather.

For the neck the most glorious type of scarf is one of Angora wool, though it has the objection of leaving fluff on the collar of your suit. It is delightfully warm and cosy, but any close-knitted or woven woollen scarf will do. Some people swear by a small towel.

In order to keep one's collar clean a good plan is to use a silk square or a silk handkerchief underneath, carefully

swathed around the collar. With these schemes and a close-fitting collar (with strap and buckle) to the coat there should be no trouble about water finding its way in via the neck, provided that a little care is taken over the dressing-up. Some collars are designed to turn up, but generally they are more effective in their usual position —turned down—since then they cannot act as a funnel. If the collar flaps against your face when the wind is blustery or the speed high, a couple of press studs will effect a simple cure.

Many modern coats are provided with fleecy linings, either as a permanency or as an attachment. In such cases there may be no call for anything thick in the way of coats as an under-layer. When such a coat is needed, a discarded cloth coat will fill the bill, although for sheer luxury there is nothing to equal a leather coat.

"There's Nothing Like . . ."

Leather can be used as the one and only outer garment, but it must be specially proofed, and reproofing should be carried out once a year or thereabouts. Coats of this type will withstand hour after hour of drenching rain, but ordinary leather will not—it soaks up water almost in the way that paper does, and takes days to dry, since anything great in the form of heat is liable to drive out the natural oils from the leather.

Waders or slip-on leggings form the usual legwear when really rough weather is about—often at other times as well—but hunting boots and field boots also have their devotees. Hunting boots are especially smart wear, though neither they nor field boots afford any weather protection for the motor cyclist's knees.

For the betwixt-and-between portion of the body motor cycle tailors now provide many forms of protection. Some coats incorporate so-called "tummipads", others have tail pieces that can be pulled underneath one and clipped high up in front. There are also various forms of waterproof knickers; certain of these wrap round one, while others are of the slip-on type. Special protection is most desirable; this until recently has been the one

weak spot in the motor cyclist's armament, but whatever the type is, it should not be tight on the legs or at the waist. The belt of one's coat, too, should be kept fairly slack.

With gloves the choice is almost legion. For sheer warmth, next to the electrically heated type, come those one-finger, fleece-lined mitts which are excellent if one's machine is fitted with foot-gear change and a twist-grip throttle. Less clumsy are the thick woolly-lined gauntlets of the normal type, but some clumsiness is a feature one has to put up with in winter.

For summer thin gloves are the goods, but something sturdier and warmer and, therefore, clumsier is essential for winter work unless handlebar muffs are fitted.

These last are a boon in really cold weather, and with the advent of the foot change have become even more practical, since one does not have to withdraw the right hand from the muff in order to change gear. They may be unsightly, but that matters not at all at times when there is a stinging nor'-easter.

Headgear

Lastly comes the subject of headgear and goggles. Flying helmets, ordinary caps, ski-caps, berets with tennis-type eye-shades, sou'westers—there are all these types and more. One desirable feature is a large peak of adequate rigidity, since it affords protection to the eyes at times when goggles cannot be worn and helps to defeat dazzle. A handlebar screen provides protection for the rider's body as well as for his face.

Of goggles there is a wide variety ranging from the simple one-piece celluloid type to racing safety-glass goggles with soft rubber edgings. Fur, while warm, is liable to collect dirt and water. If safety-glass goggles are bought be sure that they are really safe ; one's eyes are too valuable to run risks.

Day or night, wet or fine, one should always endeavour to wear goggles in order to save one's eyes. It is not often that one has to discard them so long as one adopts the dodge of the racing world—a small piece of wash-leather

sewn on the back of one of the gauntlet gloves. This acts as an excellent wiper. Where steaming is a trouble, the application of Vu-Clear, "Clarocit" or a similar preparation is advisable. Even the juice of a potato, incidentally, will help the water to run away instead of remaining to make a nuisance of itself in the form of minute, vision-distorting drops.

If you have to cover a long distance without any protection for the eyes, as, for example, on a lengthy trip through fog, it is best to bathe the eyes at the conclusion of the run. Boracic lotion should be used—otherwise, if your eyes are tender you may find that they are so painful when you close them that you have a job getting off to sleep.

What goes underneath the various outer garments must be left to the individual, but here are two hints that may be useful. First, it is worth while taking particular care over the question of keeping the wrists and ankles warm. Secondly, a thick wad of newspaper acts as an excellent impervious-to-wind breast-plate if one has nothing better on hand.

CHAPTER 18

YOUR NEW MACHINE

Running-in : Removing "Swarf" : Lubrication Questions : "Drying-Up"

SOME people do not believe in running-in. Actually it is impossible to get the best out of a new engine without common-sense usage in the early stages. Examine a new piston or cylinder under a microscope ; its surface has ribbed formation and appears so rough that it seems most unlikely that the engine will function at all. But when the running-in is safely over the barrel has an almost glazed bore and even the piston has gained a fresh complexion.

If this, and the way an engine gradually becomes freer and more frictionless, were not enough to prove the benefit that accrues, then an examination of the methods of our most famous tuners would undoubtedly convince the most sceptical—and, remember, their engines are built not in an hour, but take days, and even weeks, and, with the plug and cam gear removed, spin like a top, even when new.

It is during the running-in period that the engine settles down and the rough corners become rubbed off. The settling side of the matter is important because the processes of manufacture cause internal stresses in the components, which in certain cases are largely relieved by heat treatment. They have to be relieved in some way or another, and if we take a piston as an example it is these internal stresses that to a large extent are the cause of the distortion that we know as high spots. Let the stresses relieve themselves gradually, this is the obvious cue.

The first need is the correct lubricant, either with or without the addition of a graphitic running-in oil. Many swear by these colloidal graphite mixtures.

It is absolutely essential, however, if graphite is to be used, to buy it in the proper colloidal form.

If the oil supply is adjustable turn the regulator so that the engine receives an excess, for it is much better to oil-up the sparking plug than to run the risk of drying up the piston, and possibly scoring the barrel. On a four-stroke mix either a tablespoonful or two of engine oil or some upper cylinder lubricant with the fuel.

"Swarf"

Before we leave the subject of lubricants it is desirable to bear in mind that as a rule a certain amount of swarf—specks of steel, brass, aluminium, and other undesirable matter—finds its way into the crank case in the early stages. Therefore, the oil in a dry-sump system should not merely be topped up but duly drained—preferably after the first hundred miles. Do this when you come in from a run and everything is therefore hot. Before refilling, clean out any filters and swill out the crank case and sump with petrol, benzole mixture, or one of the special flushing oils—but *not* paraffin. To err on the side of perfect safety, repeat the procedure when five hundred miles have been covered.

The oil sump should not be run more or less empty; in normal circumstances, the larger the quantity of oil in circulation the better, for a small quantity means that on a long run the oil will become undesirably "thin" owing to heat absorption.

In running-in it is important to keep the bearing pressures low; nevertheless, very low engine revs, unless the engine is doing no useful work, are to be avoided. The idea that one should never exceed 30 m.p.h. during the first five hundred miles of a machine's life is a fallacy, and, if followed out to the letter unintelligently, is likely to harm a machine rather than, as should be the case with running-in, ensure that it gives the best possible performance.

The three important considerations in all running-in are: that the engine (1) is never allowed to slog, as, for instance, uphill in a high gear; (2) is never revved to

excess ; and (3) is given a steadily increasing amount of work to do.

With a 500 c.c. sports solo machine there is no objection at all to attaining, say, 45 m p.h. on a down-grade in the quite early stages, because the engine will be running lightly, but there must be no 45 m.p.h. three-quarter throttle climbs of hills until the engine has really had a chance of bedding down—or working off the roughness in its components that is inevitable no matter how high the skill in manufacture.

The engine *must* be allowed to turn over lightly and smoothly. This means that the gear box has to be used frequently, which is all to the good, because it will help to free it up.

At first one should seldom exceed a quarter throttle. If all feels well after, say, seventy or eighty miles, a third throttle may be used now and then ; after a couple of hundred miles half throttle may be employed. It depends upon whether the engine feels smooth and silky in operation, but, of course, in no circumstances must the revs be allowed to mount really high—even on down-grades—nor should the engine be allowed to slog. Gradually more revs may be used ; gradually the engine may be allowed to develop more power. This "gradualness" is all-important.

At 200 Miles

A halt in the proceedings should be arranged at 200 miles or thereabouts, and the various adjustments—chains, clutch, valve gear, wheel bearings, steering head, etc.—checked over just to see that all is well. Even nuts and and bolts tend to bed down when new, so that tightness of these should be examined.

At the end of four hundred miles we shall, all being well, be nearing the completion of the running-in period. The engine will have been given more and more work to do until now, under suitable conditions, it may be run up to almost full performance. Do not use all the performance until at least five hundred miles have been covered, and even then snap the throttle to every few hundred yards

in order that the underside of the piston and the cylinder bore may be well sluiced with oil. This is an excellent safety measure.

If any gruelling work is undertaken early on, or even if a considerable mileage has been covered and the engine not towsed, never tread hard on the gas without taking the precaution of having your hand upon the clutch lever so that the clutch can be whipped out like lightning in the event of the engine appearing to become the slightest bit rough or fussy. You want to run no risks of the engine going up solid. Quite apart from the fact that the machine will skate with the back wheel locked until such time as the clutch is freed, there is the possibility of the piston and the cylinder bore being damaged.

If It "Dries Up"

When an engine *does* dry up in this manner it is best to let it cool down for a bit, although it will usually free by the time you have coasted to a standstill. After this partial seizure the engine may be allowed to run-in for a further period, but it is generally best to lift the cylinder at the end of the run and examine the cylinder bore and the piston. In a very bad case there may be a certain amount of aluminium adhering to the cylinder bore and tears in the surface of the piston. Should this unlikely misfortune occur, the aluminium should be removed in part by very careful scraping and the remainder by lapping in the manner described in *The Motor Cyclist's Workshop*. The piston must be scrapped—no, not "scraped"—and the new one run-in with due restraint. By the way, running-in is, of course, necessary after a cylinder has been rebored and a new piston fitted, and is also desirable to a certain extent after the fitting of new engine bearings.

To revert to the question of the piston after drying up, the cause of all the trouble is probably only distortion—in other words, the piston has grown a few high spots, which should be traced and eased down in the way described in Chapter 37.

This running-in process admittedly involves considerable forbearance on the part of the rider, but if it is patiently

practised you will find almost for certain that your particular engine has the most pleasing characteristic of being " above standard ".

We must not think entirely in terms of the engine ; there are other little matters that must be seen to in the initial stages of a machine's life. The most puzzling of these concerns the clutch, which has the habit of bedding down, and thereby taking up all the slack in the control wire—sometimes to the point of causing clutch slip. Therefore we must watch out that at all times there is a slight amount of slack in the control cable.

Another little matter—and this applies more to a machine whose valves have been ground-in than to a mount that is new—is that the valves, initially, hammer up their faces and hammer down their seats, thus reducing the clearance.

During the first few hundred miles the whole of a new machine tends to bed down ; therefore, when you gloat over the new possession, gloat with the tool-kit and instruction booklet laid out beside you.

CHAPTER 19

CLEANING THE MACHINE

Spray-Mist—A Method that is Really Quick, Yet Sound and Efficient

IT was a dirty day, and the man who had just bought the machine said it seemed a great pity having to take it out and get it muddy. The late owner smiled—at him and also to himself, for that shining bus had been cleaned in under three-quarters of an hour and, owing to a trial the previous week-end, it had been really filthy. The machine was not spotless—definitely it was not—but it was in a condition to tug at the purse-strings of even the most hardened of prospective buyers.

The idea that a motor cycle takes an eight-hour day to clean is absurd in these times of rapid cleaning methods. An ordinary motor cycle with the usual number of nooks and crannies can be made presentable in twenty minutes. The trouble is that the vast majority still look upon the use of water, sponges, rags, leathers, paraffin and polish as the one and only cleansing method. All that many experienced riders use is a spray-gun, one of the mist-type polishes and plenty of rag. Where there is an exceptional amount of oil and grease to be moved benzole mixture and a paint brush may come in handy, but, as a rule, the spray alone will do the trick.

The sprayer costs only about a couple of shillings and the polish is cheap enough—perhaps two pennyworth for a spotless model.

Simplicity is the keynote of the work. One merely fills the sprayer and walks round the machine pumping the polish over all the enamelled and plated parts and the lamp glass and the saddle.

Then, with a piece of rag, the mud and grime are rubbed off. Assuming that the sprayer has been used to good purpose, the mud crumbles away, leaving beneath the virgin enamel, plating, or whatever the finish may be. Finally, a clean piece of soft rag is used to polish up the various parts.

In the case of spokes and the portion of the rims in the vicinity of the spoke-nipples a spoke brush is handy, but fingers are nearly as quick and there is one objection to a spoke brush—it is all too easy to stab the enamel with the stiff wire that holds the bristles in place.

There are no " secrets " about this method of cleaning. The only point is that plenty of clean rag should be used. For rubbing off the mud a piece of mutton-cloth is excellent, though some have a preference for cotton waste, which, however, is not so easily obtained.

Probably, like many another, you have doubts about this spray method of cleaning. The idea of *rubbing* off the mud fails to appeal to some for they have visions of scratching the enamel and, in the course of time, damaging it seriously.

The years have passed, however, and no such objections can be found to the scheme—in fact, no objections at all. Whereas in days gone by the writer's motor cycles were kept in a disgusting state, to-day, with little or no effort, they are almost invariably presentable. Of course, if a machine is to be spotless it takes longer than the twenty minutes postulated, but never the hours that are involved in the use of water, sponge, polish and leather. Incidentally it is far cheaper to buy the mist-type polish in quart tins than in small quantities.

CHAPTER 20

RIDING COMFORT

Saddle and Footrests : Handlebars : Control Positions : Knee Grips : Tyre Sizes : Fork Action

IF ever a motor cyclist remarks that he finds it far less tiring to cover a long journey by motor cycle than by train or coach, almost invariably he finds that there is polite disbelief. Nevertheless, there are thousands of hard riders who confirm this experience ; they, too, have found that riding comfort is almost entirely a question of the riding position and the way one sits one's mount. Many motor cyclists buy a machine and then accommodate themselves to the riding position.

But the chances are that they are by no means the stock size which the standard position suits, and a few alterations by means of the adjustments provided will make all the difference in comfort and ease of control.

When ordering a machine make a practice of specifying your normal weight in riding kit, and demanding suitable saddle springs. Otherwise, the springs may be too heavy or too light. If the latter is the case, the saddle, as a result, may bottom on the rear mudguard—a most uncomfortable occurrence.

The footrests should be arranged beneath the saddle, so that one rides on the balls of one's feet and is poised on one's legs. This is probably the greatest secret in ensuring riding comfort. Provided it is possible to ride poised in this way, resting—not sitting—on the saddle, when the machine hits a bump one automatically rises on the rests and the shock is absorbed in the natural spring in one's legs and thighs. In consequence, no solid shock is transmitted to the body ; and it is solid shock that causes aches and pains and general tiredness.

Some riders endeavour to arrange their position so

that their weight is distributed between the handlebars the footrests and the saddle. It is better, as a rule, to have the arms carrying next to no weight, with the hands resting lightly on the bars. In other words, one should so arrange the riding position that one is balanced upon the footrests and the arms act neither as struts nor tie-rods.

This ideal is usually attainable without any difficulty, though sometimes it may be found that the kick-starter is in the way (folding kickstarters are obtainable), or the bars are not the most suitable distance from the saddle.

A riding position cannot be tested with the machine on the stand, since, in such circumstances, the machine is invariably canted either forward or backward, and a false impression obtained. Instead, the machine should be held vertical with both wheels on the ground. This is easily accomplished by packing bricks and, say, slats of wood, beneath the footrests. Then one can try the position exactly as it is when the machine is on the move.

The first thing to get right is the footrest mounting. The rests must be at the right height and sufficiently well back. In Fig. 95 a man is shown balancing himself

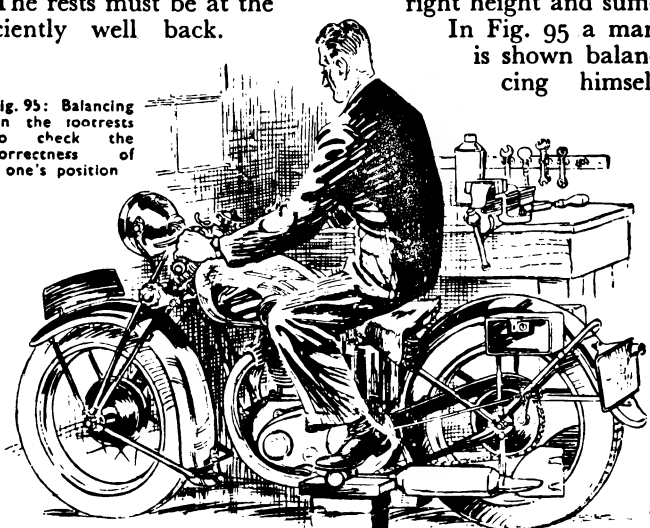


Fig. 95: Balancing on the footrests to check the correctness of one's position

on the rests, checking whether the position enables him to rise automatically. The ball of his left foot, it will be noticed, is on the rest, and not his instep, since only by the rider, in effect, rising on his toes, is the maximum possible comfort achieved.

Some saddles are adjustable in a backwards and forwards direction. This, of course, greatly facilitates obtaining a perfect relationship between the footrests, saddle and handlebars. The saddle, by the way, should not be tilted—at least, never to the extent that the rider tends to slip either backwards or forwards. If any trouble is experienced in this direction, and there is not an appropriate adjustment, it is a case of fitting either shorter springs or packing washers between the saddle frame and the springs—according to whether the back of the saddle requires raising or lowering relative to the saddle nose.

Handlebar Width

During these last few years designers have expended considerable thought upon the handlebars of their machines. To-day, sensibly, the average bar is of such a width that the rider does not have to stretch his arms out sideways. Moreover, the handlebar ends are arranged so that the rider's hands rest upon them at the angle natural to his wrists. As a rule if the bars are non-adjustable, the position standardised is a reasonable compromise. If, however, an adjustment is provided, various positions should be tried until the height and angle that seem most natural are found. These experiments should, of course, be carried out with the machine mounted vertically, as before.

When the handlebars are being adjusted, note should be made of the position of the various controls, since, if they are of the fixed type, a compromise may be necessary. Obviously, it is useless getting the bars in what one considers the best possible position, and then finding that the clutch and front brake are difficult to operate.

Testing a handlebar position with the machine stationary is not enough by itself. A position that seems ideal for comfort does not always give the best possible control,

and ease of control and comfort are, of course, closely allied. For this reason it is desirable to see that the clutch and front brake cables run in easy sweeps so that there are no unnecessary frictional losses.

Another point of some little importance is the diameter of the handlebar grips. Particularly is this so with twist-grips. A thick twist-grip is very tiring to operate. Grips of 1⅛ in. diameter are usually quite large enough for comfort. On the other hand, grips of a bare inch diameter are generally too small for proper control; you cannot grip the bars properly.

That the twist-grips and their cables are well lubricated and smooth-acting is important, and so is the amount of slack in the control wires for the front brake and clutch; if they are adjusted right up it means that the fingers have to be stretched right out to operate the controls at all, and in that position it is a real effort to exert proper leverage.

Saddle comfort can often be enhanced by slipping a sheet of sponge rubber between the mattress and the saddle-top.

The Knee-Grips

Some motor cyclists ride with their knee-grips, whereas others look upon their grips as a means of preventing their tank enamel being damaged. Where the latter is the case rubber sheet would obviously be just as useful, and better from the point of view of comfort if the tank happens to be so wide as to cause the rider to keep his knees splayed at an uncomfortable angle.

Where the grips are really used it may be found desirable to modify their position a little. This is generally not difficult, though in isolated cases the fixing studs may have to be removed and resoldered in a fresh position.

If the grips are of the type that are moulded to fit the knee, they cannot do their job of locking the rider to the machine by pinning his legs between the grips and footrests unless they are fitted in exactly the right place. Often cutting away the small knobbly portion that is designed to go in the bend behind the knee will improve the fit and the rider's comfort.

RIDING COMFORT

For riding comfort there is nothing, except rear-wheel springing, to beat a really large rear tyre. Using a 4-in. section rear tyre is generally well worth while ; in addition to improving the comfort factor, usually it wears much better than a tyre of a smaller section. So large a tyre, however, is seldom satisfactory on the front wheel except at moderate speeds. Some years ago, in a series of tests of different tyre sizes, *The Motor Cycle* found that a 4-in. section front tyre gave uncomfortably light steering at speeds over 65 m.p.h. A 3·25-in. section appeared from the tests to be the best compromise for the front wheel, giving reasonable comfort and good steering. Some riders prefer to sacrifice comfort in favour of pluperfect steering, and in that case a 3-in. section front tyre is generally best.

Tyre pressures form a subject about which there are many opinions. Except for freak hills, it is generally advisable to use pressures around those recommended by the tyre makers. These give good steering, useful tyre mileages, and reasonable comfort. Any slight variations that are made should be as a result of experiment and designed to make the machine sit the road better.

Finally comes the question of front fork action. The best steering, road-holding and comfort are obtainable with a long fork movement coupled with a soft, light spring and fairly light damping. Tightening up the fork dampers until the forks are almost solid generally spoils the steering and makes riding unnecessarily uncomfortable.

CHAPTER 21

EVERYTHING IN ORDER

Some Hints on Routine Examination of One's Machine

DRIVING a motor cycle week-in and week-out, without giving it any attention, definitely does not pay. It can be done, and a few riders seem to delight in it, but that is not the way to obtain true economy.

Checking over one's mount is only common sense; it ensures trouble-free riding and over the years it saves pounds. Let us assume that a long run is in prospect. Instead of darting from one thing to another—say, from tyre pressures to oil level—adopt a definite sequence; then there is no question of some point being overlooked. The writer's practice is to start at the front wheel and work backwards to the rear number plate. Thus the bus is vetted from stem to stern. It may take longer this way. For instance, one can save seconds by checking over all the various quarter-inch nuts when one has a "quarter" spanner in one's hands; but this, unless one is an M.A. (Pelmanism), generally means that some more or less important point is missed.

Naturally, adjustments which are not likely to require attention frequently are not checked before *every* run. For example, the steering head bearings need not be tested more frequently than once every four or five thousand miles, though the tightness of head clip nut and the handlebar fixings should be checked each time.

A clear indication of the general procedure will be gained from the ensuing description of an actual case.

EVERYTHING IN ORDER

The machine, which was about to be used for a 500-mile run, was in the garage just as it had finished a strenuous nine hundred miles, and was known to be running well.

First, the front number plate and front guard were checked over. Nothing was broken, of course, and set spanners proved that all the nuts were tight. The wheel spindle nuts were all right, and pushing the rim sideways in the forks showed that the taper-roller hub bearings had enough, yet not too much, backlash.

A couple of turns on the hand adjuster for the hand operation of the front brake were desirable. It was unnecessary to worry about putting the front wheel on its stand and then spinning the front wheel to see that the brake was not binding, for the free movement of the cam lever showed that all was well in this respect. The cables, too, were all right.

The front tyre pressure was not, however; it needed the application of a pump.

Next in order from front to rear came the head clip, the handlebar and fork spring fixings, the controls and the cables, lighting and otherwise. This was a rapid survey, mostly with suitable spanners in hand—set spanners, of course, not those of the adjustable variety. All was well, and all the lamps and the dipping switch functioned properly; all except one point, namely, that some of the lighting cables were rubbing on the fork blades; the clips were rearranged.

The tank fixings were known to be all right, but it was time for a new fabric filter in the oil tank; in it went, and the old one put in a clean tin ready for the day when it would be washed out with petrol. Then came topping-up with oil and checking the oil level in the chain case. There was no testing the primary chain adjustment, for the chain happened to be of the self-adjusting type.

The power unit was also known to be all right, but the plug gaps were due for checking. Yes, they needed it, and a wipe around the mica on the outside to remove grime and mud-splashing was desirable too.

The all-enclosed, all-lubricated valve gear, experience showed, would be all right. With exposed valve gear the

clearances would have been checked, and, if necessary, reset, since backlash spells hammer, and hammer means wear. Also, if the chain had been of the usual type, the tension would have been checked, because slackness and rapid deterioration in chain and sprocket condition go hand in hand.

Engine fixings were all right, and, as the rider's eye travelled over everything, he automatically took in the fact that the frame was as the makers meant it to be.

Next in order was the gear box. Some more lubricant was required here, and the foot control needed some, too, while the clutch cable could do with a little more slack; owing to the clutch bedding down a bit, the operating rod in the mainshaft was nearly up against the adjusting stud. Now the saddle, the studs on the damper plates for the spring frame, topping up the battery, the rear chain, the mudguard, the rear number plate, the wheel, the tyre, and so on, just as was the case with the front wheel assembly.

The job was done, and it has taken much longer to talk about it—or, rather, write about it—than it did to complete the work. That, however, is the general scheme. Normally it occupies ten to twenty minutes when it is a mount one really knows, and wear and tear are cut down to a minimum, money is saved, and anxiety banished.

CHAPTER 22

EASY STARTING

Suitable Engine Oils : Fuels : Ignition Faults : Carburation : Hints on Kickstarting

STARTING a motor cycle can and should be effortless. When it is difficult the custom is to blame the manufacturer. Sometimes the fault *is* the maker's, for he has, perhaps, failed to see that the kickstarter has a suitable gear ratio, but in nine times out of ten the major portion of the blame must be laid at the garage door of the owner.

To-day there are many oils on the market which, while they retain their viscosity or " body " at high temperatures, are still fluid when the thermometer hovers around freezing mark. Thus even with an old engine that is fitted with a cast-iron piston (or pistons) there is no reason for the owner to put up with " gumminess "—in other words, find that in cold weather it is next to impossible to rotate the engine by means of the kickstarter.

Various oil firms have standardised lighter lubricants. A grade which was treacly when cold is now in many cases fluid. Should difficulty be experienced in rotating an engine when the weather is cold, consult the oil firm of your choice or *The Motor Cycle* Queries Department.

A simple dodge often adopted by riders of two-strokes is this : instead of stopping the engine on the throttle before putting the machine away for the night, they stop it by placing a hand over the air intake.

As a consequence there will be a certain amount of mixture in the crank case ready for the next time the machine is taken out.

Another point which is worth bearing in mind by those who own petroil-lubricated two-strokes is that, if the machine is left for a lengthy period with the float chamber full of mixture, there is a chance that the petrol and oil

will separate and the oil affect the starting. The time-honoured remedy is to turn the fuel tap off a few hundred yards before the destination is reached so that the carburetter will be almost empty.

Do Petrols Differ?

Now to consider matters that affect all machines. First, there is the question of the fuel used. In peacetime there is often a very real difference between the petrols on the market, as can be found by trying, first, a famous brand in a petrol lighter and then a cheap grade. Therefore, if starting is poor and you are using a cheap petrol, see what the effect is of a first-class brand.

Assuming that a suitable fuel is being used and the engine is in sound mechanical order and does not gum up owing to the employment of an oil that is viscous at low temperatures, there are only three essentials for perfect starting : (1) a proper mixture in the combustion chamber ; (2) a sound spark at the plug points ; and (3) a swinging kick on the kickstarter.

The question of dropping the valve lifter of a four-stroke (if fitted) at a suitable point in the kickstarter stroke can be dismissed because, as will be seen later, in normal circumstances the experienced rider seldom uses the valve-lifter when actually starting up. There is one item which cannot be dismissed, for it is a frequent cause of difficult starting, and that is the proper functioning of the magneto control. Often, when an engine backfires instead of firing in the proper direction, the cause is the contact-breaker cam ring sticking or the control cable not sliding freely in its casing ; either will, of course, result in the magneto being too far advanced. although apparently the rider has dutifully retarded it.

Therefore, if the engine has a habit of kicking back, see first that the contact-breaker cam ring is following the movement of the control in the way it should. The remedy, it need hardly be mentioned, is to fit a new cable or clean the cam ring and smear it with the slightest trace of grease, or both. Sometimes the cam ring needs gentle " easing " with emery cloth.

The magneto, including the condenser, or, in a coil set, the coil and condenser must, of course, be in perfect condition if the starting is to be all it should be. Contact-breaker gap is important and the platinum points should be set so that they open to the amount specified in the maker's booklet. In addition, the points must be clean and bed down truly, and, in a magneto, the slip ring and the face traversed by the contact-breaker's carbon brush should also be quite clean.

Poor starting is sometimes caused solely by the high-tension pick-up side of the magneto. Oil and dirt on the slip ring can result in a lot of trouble.

Another more elusive source of trouble is a minute crack in the carbon brush holder. Incidentally, the brush should, of course, slide freely in its holder and the nice polish normally to be found on the end of the brush where it beds upon the slip ring should not be disturbed.

A surprisingly frequent cause of difficulty is a chafed or perished high-tension cable. When the cable is clipped out of harm's way, sooner or later there is leakage to the frame, and if it is not clipped up it is almost certain eventually to chafe through or be burnt. Cable is cheap enough, and it is never advisable to trust it indefinitely. This cable question is particularly important where coil ignition is fitted; the condition of the wires and connections should be checked regularly.

So much for the magneto, coil and their appurtenances. The sparking plug comes next, and here it must be remembered that we need a spark at the points —not one inside the body. Therefore the plug must be of the correct type and clean, and it should be remembered that the points of a plug slowly but surely burn away, with a result that the gap should be reset if it differs appreciably from the one specified by the makers.

The method whereby the gap should be altered is to bend the outside electrode or electrodes very carefully —never the central electrode. Sometimes, however, it will be found that the central electrode is very slightly out of centre and if this is so quite possibly the correct

gap can be obtained merely by arranging the plug centre in a slightly different position in relation to the plug body.

To clean a plug scrape the body with a knife and polish the inside and the central electrode with fine emery cloth ; for the mica of the plug centre use a benzoley rag, since it is desirable to avoid scratching and flaking it. The surface of the insulator between the plug terminal and the body should be clean and dry to obviate possible leakage.

Lastly, we come to carburation. A few years ago the secret here was to get the pilot jet setting right and then start up with the throttle control barely open. But this dodge does not always act too well with modern designs, and the vast majority of the machines to-day are started with the throttle about a third open and, generally, the air full open. The word " generally " is used in connection with the air lever because certain manufacturers believe in turning out their machines with the carburetters set on the weak side.

The best position of the controls, therefore, varies somewhat, and there is no golden rule. Two things which are necessary, however, are : (1) That there are no serious air leaks, and (2) that the pilot jet is carefully set in accordance with the instructions issued with the particular instrument.

Air leaks in a two-stroke engine may occur at the crank case joints, the main bearings, the cylinder base, and at the carburetter fixing ; in a four-stroke the chief point to watch is that the inlet valves are a good fit in their guides.

If the carburetter has a flange fitting, naturally the jointing washer must be in sound condition.

Just as air leaks can upset matters, so (and to an even greater extent) can excessive flooding of the carburetter. Not only can the mixture be too rich in petrol to fire, but also neat petrol may bridge the sparking plug points. Usually the carburetter should be flooded merely so that petrol just oozes from the base of the mixing chamber, and then only if the engine is cold.

Now, finally, is the question of the way the kickstarter

is used. As all riders of experience know, the word " kick " in kickstarter is misleading ; you don't kick, but give the pedal a long, swinging push.

The first part of the pedal's stroke does not count for much—you are only getting the engine under way. What does matter is the spin you give the engine as the pedal reaches the very bottom of its travel. A little practice with a warm engine and the valve lifter or the compression release raised would teach quite a number of riders how to give this highly desirable final impetus.

Four-stroke singles, it will be agreed, are the least easy type to start, yet there is one method, often mentioned but still not widely enough known, that will enable even the hottest of high-compression singles to be bumped over without effort. Let us trace the scheme from A to Z, A being the point where the controls are set and the carburetter flooded. First, the starter pedal is pressed down either once or twice with the valve-lifter raised. Secondly, the valve is dropped and the pedal pushed gently downwards until compression is felt. Next, the valve is raised again, and the pedal pushed down about an inch. Then the valve is dropped, and, without more ado, the pedal is given the long, swinging push. Over compression the engine bounces, and if the items mentioned previously are in order it is practically a certainty that the engine starts.

The whole point, of course, is that by this method you have three idle strokes of the piston before you hit " compression ", and during those three strokes you get the engine spinning ; moreover, there is no question of your failing to drop the exhaust valve at the right moment—you are not using the valve-lifter at all.

CHAPTER 23

SAVING PETROL

Speed and Consumption : Carburetter Adjustment : General Mechanical Condition and Economy

IT is a strange fact that the easiest way to save petrol is, for most of us, the most difficult. If only we will refrain from using our acceleration to the full and cease driving fast *we can save up to fifty per cent.* of our fuel bill.

To quote a specific instance. One evening a motor cyclist had to accompany a slow car from a point near Stroud to London. On very fast road work the normal consumption of his five-hundred hovered around fifty-five miles to the gallon. That evening with no following wind and without any special care on the rider's part the consumption worked out at just over 115 miles to the gallon.

Speed costs money—big money—for wear and tear as well as in fuel bills; and those who do not find motor cycling amazingly economical almost invariably have only themselves to blame.

Widely varying types of machines, give almost exactly the same fuel consumption at high touring speeds. For instance, on test a three-fifty camshaft, a push-rod five-hundred, and a six-hundred four-cylinder all used roughly a gallon of petrol every fifty miles at an average of fifty ; yet each, when tried for consumption at a steady thirty, gave over 100 m.p.g.

This, therefore, is the first thing that those who wish to save fuel should remember—that there is a definite relationship between speed and consumption. Next, every time the brakes are applied you are using up momentum, and that means you are throwing away energy which, in turn, spells petrol. When economy is the watchword there is no pinning down the machine for a corner

and no hurried opening up afterwards. Instead, the machine should " roll " into the corner and " roll " out again. As far as reasonable the running should be on a set throttle opening, a practice far more usual in the days of lever control than in these times of quick-opening twist-grips.

When acceleration is required it should be gentle, and the cruising speed should be that which experience proves to be the most economical. This latter varies according to the size and type of machine. On one special test there were two motor cycles accompanying one another over a set course. One was a five-hundred o.h.v. solo and the other a six-hundred o.h.v. sidecar outfit. On the first day the sidecar led the way with its speedometer needle kept more or less stationary at the " 25 " mark. At the finish of the day's run the consumption worked out at 84 miles to the gallon for the sidecar and just over 100 m.p.g. for the solo.

Next day it was the solo's turn to lead. The rider cruised at 28 to 30 m.p.h. and found at the end of the journey that he had averaged 117 m.p.g. ; the consumption of the outfit, however, was only 76 m.p.g. Thus the sidecar man, since economy was a big point in the test, wanted the lower speed and the solo rider was all in favour of the higher one. The test lasted days, so the arguments were fierce, but that is by the way.

Economy on Hills

Generally it is more economical in fuel to let the engine pull on a gradient—though not slog—than to change down early and allow the engine to rev. In order that the maximum performance on a given throttle opening be obtained, intelligent use of the ignition control is necessary. Those who cannot tell by feel whether the control is being used to the best advantage must keep a watchful eye on that infallible guide, the speedometer needle.

Where the achievement of a low fuel consumption is being treated more or less as a fine art, the ignition control must be used as much as, if not more than, the throttle. In passing it may be mentioned that, often, a mile or two

per gallon will result if rather more ignition advance than the makers specify is employed, but this, of course, means that still greater use must be made of the control, and in the case of magneto ignition, may render the starting a little difficult.

Many look upon the carburetter as the be-all and end-all of fuel consumption, but if its setting is as standard the saving possible will be relatively small in comparison with that which can be achieved by adopting the most suitable driving methods. And there is one big trap, into which, to judge from *The Motor Cycle* Queries Department's post-bag, hundreds fall : they believe that the weaker the carburetter setting the lower will be the fuel consumption. The setting can easily be too weak, and then because a much larger throttle opening is required for a given speed the consumption will be worse instead of better.

Setting the Carburetter

The only way to set a carburetter properly is to read the maker's instructions and then experiment, altering one thing at a time and keeping careful check upon the results. Do not go from one extreme to another when carrying out an adjustment—a little at a time is much the better plan—and remember that since for economy we shall be running mostly on small throttle openings, by far the most important point is the pilot jet adjustment.

When an engine is properly warmed up it will generally be found to thrive upon large quantities of air. So much is this the case that the man who takes a delight in handling controls effectively and does not mind having another one will usually find that an extra air valve fixed between the carburetter and the inlet port and operated from the handlebars will more than pay for itself. But here again careful usage is desirable. Extra air can add a number of miles to the gallon, and on down grades, by leaving the control open and the throttle shut, one has an excellent additional brake, but too weak a mixture can cause burnt exhaust valves, burnt seats, and even a burned-through piston crown.

Obviously, the valve must be fitted properly and be well made, since otherwise there will be an air leak that will probably render starting difficult.

With certain air-cleaners and gauzes of various sorts at the air intake, a not infrequent cause of excessive fuel consumption is mud and dust. Naturally, the greater the obstruction presented to the entry of the air the greater the suction on the jet and the richer the mixture.

Another often unsuspected cause of waste is leakage. In peacetime there is an easy way of determining whether the carburetter, the petrol tap, the filler cap and the various joints and unions are leaking ; that is to use a coloured fuel. The red stain of an ethylised petrol shows up the trouble immediately, and it is surprising what a difference the cure of an apparently slight leak will often make to the consumption. A couple of tablespoonfuls of engine oil added to the petrol will also act as a leak detector.

Checking off the Cycle Parts

Before discussing engines and engine condition, let us turn to a few points which are sometimes looked upon as forming the less interesting side of a motor cycle. First, are the wheel bearings free? Are the brakes right off when they are supposed to be? Do the wheels spin freely? If not, fuel is being wasted. Is the gear box lubricated with the correct lubricant and the proper quantity? Are the chains and sprockets in good order, properly lubricated and correctly adjusted? More good petrol is being thrown away if this is not so.

Now for the engine. Pride of place is taken by the cylinder bore, the piston and the piston rings. These are especially important in a two-stroke. If the cylinder barrel has become oval through wear, or scored, or the piston rings burnt—in other words, if the compression is no longer all it should be, then attention is required. One *must* use the power of each explosion to best advantage.

The greatest mechanical loss in an engine is piston friction, so if there are any high spots on the bearing surfaces they should be eased very carefully with a fine

file—one no coarser than a nail file. High spots on an aluminium piston are fairly easily detected; if they are present they will be apparent as bright areas standing out in relief against the slatish grey of the remainder (see Chapter 37).

By the way, while we are talking of pistons, it is surprising how many two-stroke owners remove their pistons and then forget that they must be put back with the steep side of the deflector facing the transfer port.

The condition of valves and valve seats is important, but more important still is the state of the valve springs. Weak springs mean that the valves do not follow the cam profiles, and sluggish closing of the inlet valve spells fuel wastage owing to blow-back through the carburetter. There is always a certain amount of blow-back due to the sudden closing of the inlet port, and not a few riders believe in using an extension to their carburetter intakes in the hope that a mixture blown back at the end of one induction stroke will be caught on the next one.

When a machine is old the valve timing is sometimes open to question. It should be checked with the standard timing. Cams seldom wear seriously; more often the wear is to be found in the cam rockers and their bearings. Two final points: The correct tappet clearances should be maintained and the plug kept clean and the points set to their proper gap, so that there is no question of it sparking internally.

CHAPTER 24

OBTAINING SILKY RUNNING

Use the Right Petrol : Chain Maintenance : Shock-Absorbers : "Soft" and "Hot" Plugs : Carburation

IN traffic, or when one is tired, a machine that is harsh and intractable is a nuisance. It seems to take away almost all the pleasure from one's run. Yet there is no valid excuse for harshness. When a motor cycle is not supple and silky the fault is the designer's or the rider's —probably both. Happily, except for a few hyper-sports mounts, there are no modern motor cycles that will not provide reasonably silky, supple running.

With a high-compression engine the first consideration is the question of the fuel to be employed. It is no use expecting a five-hundred single with a 7½ to 1 compression ratio to give of its best on ordinary straight petrol ; unless the combustion chamber is good and the volumetric efficiency low it won't do it.

A fuel with a high anti-knock value is essential. From this standpoint some straight petrols are considerably better than others. Therefore, with a standard engine that is rather carboned, or with a unit that is merely "fairly hot," a little judicious experimenting with various brands can pay.

For a hot-stuff engine standard petrol-benzole mixture may prove the goods ; otherwise one should in normal times turn to an ethylised or alcohol fuel, or mix petrol and benzole oneself. A pukka fifty-fifty mixture of first-class straight No. 1 petrol and pure benzole is usually recommended for T.T. replica type machines, and is altogether an admirable fuel, but very, very few garages stock the necessary pure benzole—more's the pity.

The most usual cause of harshness in a standard machine is the transmission. Contrary to the belief of some, chains

are not a positive drive ; if in good order, correctly adjusted, and properly lubricated and aligned, a chain is in itself something of a shock-absorber. The chief reason for this is the cushioning effect of the oil at the many bearing surfaces.

Unfortunately, chains seldom receive the attention they need and deserve. First, it is essential, if the machine is to be free from snatch, that the driving chains be kept in correct adjustment. Run them too tight—there will be harshness ; run them too slack and there will be snatch. And in either case there will be rapid wear. Chain adjustment is a matter that demands careful attention.

Both the sprockets and the chains must be in perfect order. It is no use putting a new chain on much-worn sprockets or using new sprockets with a worn-out chain. When, as is often the case after a little use, the chain wears unevenly, causing a tight spot in the run, make a point of adjusting for the tight spot.

Obviously, the cushioning referred to previously can only occur if the chain is properly lubricated. The oil level in an oil-bath case must be checked up religiously, and adjustments to level and chain tension made as and when they are necessary. If the crank case breather exudes into the bath there is a big chance of condensation occurring, with a result that it is a good plan to drain the case at least twice a year and wash it out with paraffin or a flushing oil.

Where no oil bath is fitted the chain should be removed periodically. How often it should be removed depends upon the weather and the nature of the roads traversed. Many remove unenclosed chains once every thousand miles in dry weather, and after every " dirty " run. The scheme for replacing rear chains is to join an old length of chain to the one that is being removed and then pull the latter off, leaving the scrapped chain dangling in position on the front or driving sprocket, so that it in turn can be used to pull the clean and greased chain home again.

Many riders find it a struggle to replace the spring link, and sometimes, in desperation, slacken off the adjustment in order to get it home. The tip here is to arrange

the chain so that its two ends enwrap an equal amount of the larger of the two sprockets. By pressing the chain rollers home between their respective teeth it is generally easy enough to get the end links into correct location for slipping in the connecting link, even if the chain is an old one and the freshly inserted grease is taking up much of the slackness. Another dodge is to use a piece of stout string, block and pulley fashion, round the end rollers. In any case, there are clever gadgets sold for this very purpose of pulling the ends of the chain together.

Chain Lubrication

Chain lubrication is looked upon as a loathsome business, and for this reason any number of motor cyclists don't bother about removing the chains, but squirt oil on them *in situ* in the pious hope that the lubricant will find its way inside to the bearing surfaces where it is needed.

This is liable to be next to useless. The best plan is to keep a deep tin, with a lid, for washing the chain, and an old saucepan for the lubricant. First the tin is half filled with paraffin ; then the chain is dropped inside, the lid put on, and the tin rocked. This swilling of the chain cleans it like lightning.

Next the chain is hung up on a nail so fixed that any paraffin drippings fall back into the tin. A few minutes for this to happen, and the chain is put in the pan, which contains stiff grease heated sufficiently to make it fluid. Except in cold weather there is no need to apply heat while the chain is actually in the pan—the grease will keep fluid sufficiently long. A quarter of an hour, and then the chain is hung up again, this time to drip into the pan, and that is that, except for wiping it and replacing it on the machine.

Some riders of an economical turn of mind use old oil that has been drained from their sumps in place of grease, but the trouble is that oil finds its way out too quickly. Grease to which graphite has been added is probably best of all.

So much for chains ; almost equally important is the shock-absorber. If this is of the spring-loaded cam

type it should be cleaned thoroughly every four or five thousand miles. Before pulling it to pieces mark it with an indelible pencil so that the floating member is replaced on the same splines and the cams mate exactly as before. Wash the parts with paraffin and, if they are rusty, polish the bearing surfaces with very fine emery cloth. Then wipe them clean, smear them with grease, and fit them together again.

Some shock-absorbers of this type are adjustable for spring tension or, to be accurate, spring pressure. The best results are usually obtained when the adjustment is such that the cams just cannot ride.

The other form of shock-absorber—the rubber buffer type—requires no attention beyond making sure that the blocks of rubber are still sound.

The man who uses a high-compression machine for week-day traffic work and for week-ends on the open road is often well advised to keep a "soft" touring plug for the former, changing it for a "hot" one when open road work is in view.

Generally, carburetters are taken very much for granted, but it is surprising to find how sucking-dove-like an expert can make a machine just by casting his wizard hands over the "gasworks". Much helpful information will be found by those who delve into the carburetter maker's booklet. Follow it with care and understanding, and the chances are that you will obtain a marked improvement both at small throttle openings and as regards opening up. A final word: too much ignition advance spells roughness.

CHAPTER 25

IN SEARCH OF SILENCE

Chains : Valve Gear : Piston Slap : Brakes : Clutch Chatter : The Exhaust System

THERE is a fascination about a motor cycle that glides along with not a sound other than a mellow whine or gentle burble from the exhaust—a machine without a solitary rattle or tap or clatter. Such a machine feels silky and, since there is no clatter or other wear-denoting noises, it generally *is* silky.

But, while it is easy enough to enthuse over silent running, and to point out that silence enables one to make the fullest use of a snappy performance, it is extremely difficult to eliminate or even reduce noise.

Primarily, the matter is, of course, one for the designer and the manufacturer, and the making of truly silent machines is unfortunately costly. We, on our part, have to take machines as they are and not as we might like them to be. We cannot ensure, for instance, that the timing pinions fit so perfectly that they emit not even the tiniest hum, or redesign the cams, the valve gear, the cylinder finning, the piston and the many other items that make for noisy running. Nevertheless, we can prevent noise developing through maladjustment or under-lubrication, and we can often do much to tone down the exhaust.

Some noises are emitted only from the machines of the lazy. Chains hitting their guards are an example; another is the clatter of valves when their clearances are excessive, and a third, loose mudguards and fittings. The cure in such cases is obvious, and the remedy should be applied at once, because clatter means wear, and further wear means a worse clatter, and eventually this policy of "leaving until the morrow" will prove hard on the pocket.

There is one noise in connection with chains that is often overlooked—the noise caused by magneto and dynamo chains. So trouble-free is such a drive when encased that few ever look at it from one year's end to the next, but a magneto chain *does* wear, and sooner or later it begins to hit its case, causing a noise that cannot readily be detected.

With the engine there is little that the owner can do other than seeing to its proper lubrication and keeping everything in perfect trim, replacing parts when wear becomes excessive. Wear can, however, be considerably reduced by common sense precautions. First, the oil in an engine lubricated on the dry-sump system must be changed periodically and not merely topped up. Secondly, any filters in the lubrication system must be cleaned out regularly and the whole system, including the crank case, flushed out with either a flushing oil or petrol. Thirdly, when a machine is started up from cold it should be allowed to run fairly lightly until it has warmed up and the oil gets " moving ". These are only matters of common sense, but the adoption of such practices pays hand over fist.

By the way, if the makers of your machine list quick-lift cams and strong valve springs as optional extras, never specify them unless you really want the last couple of miles an hour and those few feet per second. That " little extra " costs a lot of wear and tear, and generally adds quite a bit to the work of maintenance, as well as spelling a noisy exhaust.

O.H.V. Gear Lubrication

One little point that is apt to be overlooked in connection with exposed overhead-valve gear is the need for seeing that the bearing surfaces receive plenty of the correct lubricant. " Little and often " should be the motto here, and any side play that develops in the rockers should be duly taken up. Another small point is to see not only that the thimbles at the ends of the valve stems are in perfect condition but also that they are free to revolve—otherwise wear will be unnecessarily rapid.

Care, too, should be taken to see that any oil leads to the valve guides are properly cleaned out every time the head is removed for decarbonisation; in addition, with a four-stroke, it is well worth while mixing either an upper-cylinder lubricant or a touring-type engine oil with the fuel, thereby ensuring, at least, that the inlet-valve stem is nicely lubricated.

Piston slap is a noise that thoroughly annoys some riders, but unhappily it is a question of design: of the piston length, of the alloy used, of the construction and of the clearances. Where a make of machine invariably suffers from piston slap, the only possible course is to approach a firm of piston specialists and see what they can provide.

Sometimes manufacturers, in order to meet a rider who takes strong exception to piston slap, will supply a piston with smaller clearances than standard with instructions that the piston must be run-in really carefully and the remark that the rider must not be surprised if, when he drives hard, the piston should seize. Not infrequently machines are turned out as standard with large piston clearances simply because the makers have found that riders will not take the trouble to run-in their new machines properly.

Often, of course, piston slap is merely the audible result of wear—wear which, by the way, is accentuated by slow-running in top gear—and a cure can be effected by having the cylinder rebored and an oversize piston fitted.

Squeaking Brakes

One of the most irritating of all noises is the squeaking of a brake. This is often caused by grit, and the cure in such a case is to remove the brake shoe plate, wash out the drum with petrol and scrub the linings with a nail-brush dipped in petrol. At the same time, make certain that none of the rivets fixing the linings is standing proud. If they are not nicely countersunk tap them inwards with a suitable punch and clench them over

again ; also, if need be, ease the leading edge of the lining with a coarse file.

Another possible noise is the chatter of clutch plates when they are taking up the drive. This is caused by backlash between the driving and driven members—in other words, between the tongues and the grooves—and a remedy is to have the tongues built up by welding.

Exhaust Noise

The question that is probably asked most frequently is : " How can I reduce the noise of the exhaust of my old-type machine ? " This is generally accompanied by a further question : " Will it be all right to insert pan-scrubbers in the silencer ? " The answer to the second point is, " No ! " because pan-scrubbers have a nasty habit of being driven into the rear of the silencer by the exhaust and eventually choking things up to such an extent that the back pressure becomes dangerously high—dangerous, that is, from the point of view of performance and the future of the exhaust valve and its seat. In some silencers their use may be all right, but usually, unless the owner is prepared to go to the lengths of having an entirely new exhaust system, it is best for him to confine his attention to the tail pipe and fishtail.

The Brooklands type of fishtail that has been so popular generally gives rise to an unnecessarily high-pitched " crack " and all too frequently it is flimsy in construction and vibrates. Far better, as a rule, is the tubular type of fishtail that once upon a time went under the name of the " T.T. fishtail ". This consists merely of a straight piece of tube tapering to a slit at its rear end and liberally drilled with small holes.

The important part is the small holes. One of the most efficient silencers ever produced consisted of a long pipe drilled with a multitude of very small holes, the " wire-drawing " effect upon the gas as it passed through the holes reducing the temperature and pressure of the exhaust until it was practically noiseless. This is not to suggest that a well-drilled exhaust pipe with just a blanked end should be fitted—such an arrangement would

hardly be popular with the police ! But, where the minimum expense is desirable and the machine is fitted with Brooklands-type fishtails, the ends of these fishtails should be closed to a narrow slit with nuts and bolts, plus washers as distance pieces, and the outer sides of the fishtails drilled with rows and rows of eighth-inch holes. This will usually be found to effect a very useful reduction in noise, but beware, if you carry a pillion passenger, that the gas, with its quota of oil, is not ejected upon your passenger's legs !

The adoption of bolts and washers as distance pieces will by itself go a long way towards the elimination of fishtail drumming.

A better scheme than using drilled Brooklands-type fishtails is to fit new tail pipes, blanking off the front end ; drilling the portion that protrudes into the silencer with smaller holes than of yore, but more of them ; fish-tailing the rear end to little more than a slit ; and liberally drilling the portion that is out in the open air. Obviously, the greater the length of this latter portion and the smaller the holes are in size, the higher will be the degree of silence, while the larger the number of holes, the lower will be the back-pressure.

Sometimes a considerable amount of noise from the exhaust is none other than silencer drumming caused by the use of thin sheet metal for the expansion chamber. In such a case there are two schemes that may be adopted. One is to lag the silencer, binding it with stout asbestos cord, and the other is to stiffen up the silencer with the aid of long bolts running right through it, or, to be accurate, across it.

CHAPTER 26

GOOD STEERING

Riding Position : The Steering Head : Damper Faults : Hub Bearings : Tyres : Fork Play : Wheel Alignment : Tyre Size and Pressure : Sidecar Steering

ONE motor cycle steers really well ; another doesn't. Why should this be so ? Actually, there may be many reasons, some the concern of the designer and others due to the owner. While in this chapter one or two matters will be touched upon that are primarily the designer's job, the majority of the points mentioned apply to the rider and the rider only.

The question of securing a good riding position was discussed in Chapter 20. It must be realized that good steering and a comfortable riding position that ensures easy control are co-related. You cannot expect a machine to steer well if your riding position is a bad one. Fully half the criticisms that arise in connection with steering are due to the fact that the rider is thrown about, and, in being thrown about, swings the handlebars. Were he to ride on the rests with little or no weight on the bars, no worries would occur.

The modern machine, assuming everything is in line, and there is no backlash in the forks, steering head or wheel bearings, steers itself. The handlebars are largely rests for the hands, the actual " persuading " the machine round a corner or bend being accomplished almost entirely by leaning it over by means of the thighs. In normal circumstances there is neither reason nor sense in gripping the bars like a drowning man and his straw. Some machines definitely object to this practice, the best steering being obtained only when the rider keeps his hands loose on the bars. Some years ago a certain machine gained quite a bad name for its steering qualities ; people said it wobbled, but it was they who caused it to wobble.

First and foremost, therefore, the aim must be to obtain a comfortable riding position—one which enables the rider to poise on the footrests, using the natural spring in his legs to absorb road shocks and prevent him being thrown about. The next thing is handlebar shape and width. To-day the majority of handlebars are reasonably narrow, which is as well, since you cannot ride properly with your arms splayed out. Until recently it has been the practice of many experienced riders to lop off 1½ or even 2 in. from the end of each bar. Now bars are usually narrow enough.

The angle of the ends of the modern bar is also good, as a general rule. The ideal here is that they are so positioned that the hands rest on them perfectly naturally. On many machines the bars are adjustable, and it is well worth while trying the various possible arrangements. Another good point of machines of to-day is that the handlebar grips are usually of a sensible diameter—neither too thick nor too thin. This point is more important than it may seem.

The Steering Head

From this let us turn to matters affecting the cycle parts. First there is the question of the steering head, which many riders never touch from one year's end to another. A pitted head race will spoil everything, and so will damaged balls or rollers, as the case may be. If the steering is open to question and the machine has not been dropped, or there is no apparent reason, examine, first, the steering damper, and, secondly, the adjustment of the head.

A tendency to roll is often traceable to the steering damper. The trouble in such a case is that the anchor plate is fixed so that it is not true with the other plates. This can be checked by slackening off the damper and taking a good look at the plates—the fact that the middle plate is at an angle is generally apparent to the eye.

To remedy the trouble, undo the stud holding the anchor plate, tighten the damper knob right up and bend the plate or fit a packing washer so that when the

stud is refitted the anchorage is no longer strained but held in its correct relative position.

Tightness of the steering head will also cause rolling, and, sooner or later, rank bad steering. To check this adjustment, place a box or a few bricks underneath the crank case so that the front wheel is held clear of the ground. Then swing the handlebars ; if there is stiffness and there is no question of the damper binding, the adjustment of the head should be slackened off a trifle. If, on the other hand, the bars swing easily for part of their movement and stiffly for the remainder—in other words, if there is a suspicion of jerkiness—the chances are that the head races are pitted or one of the balls or rollers is broken. In any case, the head must be stripped and examined.

Good steering cannot be obtained with doubtful head bearings. They must be adjusted so that the handlebars swing perfectly freely, yet without any backlash. The soundest way to test for play at the head is by " rolling " the front wheel backwards and placing a finger across the gap between the head clip and the head. One can thus detect even the barest trace of play.

Adjust with Care

Considerable care is necessary in adjusting the head, because if, by some mischance, the bearings are over-tightened a fraction the races will be damaged—or, if not the races, the balls or rollers, as the case may be. The motto in head adjustment is to tighten a trifle and test ; tighten and test, and so on until the adjustment is dead right. Never, with any ball or roller bearing, screw the adjusting nut right up and then slack back.

If the hub bearings are of the taper roller type, remember that a speck of backlash is essential ; there should be, roughly, 1/64th in. side-play at the wheel rim. Correct adjustment of the wheel bearings is, of course, necessary if the steering is to be satisfactory, and the tyres must be true with their rims. In this latter connection a moulded line will be found on each tyre wall ; this is a guide as to whether the tyre is really true. The line should be

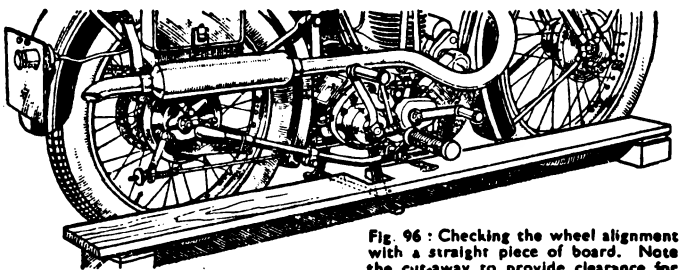


Fig. 96 : Checking the wheel alignment with a straight piece of board. Note the cut-away to provide clearance for the central stand

equidistant from the rim all the way round. Damage to the rims, such as buckling, will also affect the handling of the machine.

Any side-play in the forks must be eliminated. With the forks of to-day this is easy, and, if the method of adjustment is not obvious, it is almost certain that the instruction book makes everything quite clear. Often on old-type forks no adjustment was provided ; in this case thin steel washers must be fitted between the links and the blade member or head member, whichever it is. Occasionally, through the owner's failure to keep the spindles properly greased, backlash develops in the spindle bearings. This will spoil the steering entirely, and, while the forks can sometimes be bored out and oversize spindles fitted, new parts are generally required. Therefore, remember to keep your forks well greased ! If you find that the grease does not seem to be getting where it is required, see first that the nipple is clear, and if this is so remove the spindle and clean it and the housing with petrol and a rag ; if necessary, use fine emery cloth.

Now we come to the question of wheel alignment. The standard method of checking the alignment is to use a straight piece of board some six feet long ; lay it along the wheelbase of the machine and, holding it as high as the design of the machine will permit, make certain that it touches each tyre in two places (Fig. 96).

On the average machine it is not the slightest use counting the number of threads by which the chain adjusters protrude in the hope that this will provide a clue as to

whether the wheel is square in the fork ends and the wheels in line. If there is any doubt on this point, the alignment must be tested by the piece-of-board method ; incidentally, if a central stand is fitted the board can usually be cut away to provide the necessary clearance. Once the correct alignment has been obtained, a centre punch dot made in the end of each adjuster will ensure that in future there shall be no doubt as to whether one adjuster has been turned more than the other (Fig. 97).

Another little point one should be on one's guard against is that when the rear chain is adjusted the wheel is pushed right forward in the fork ends, and the nuts are then tightened up evenly ; it is more than likely that wheel will not be square, and, therefore, the alignment out, if a little care is not taken in this direction.

Tyre pressures, of course, affect road-holding and steering. Even more important are tyre treads and the size of the tyres. The best high-speed steering is obtainable with a 3-in.-section front tyre. Larger section tyres on the front wheel never give quite the same feeling of positiveness, and for fast work many believe in having a ribbed tread, which is used almost universally on road-racing machines.

No mention has been made of malalignment caused by bent forks or a twisted frame and how these points may be checked and corrected ; this is a workshop matter, and is very fully covered in *The Motor Cyclist's Workshop*.

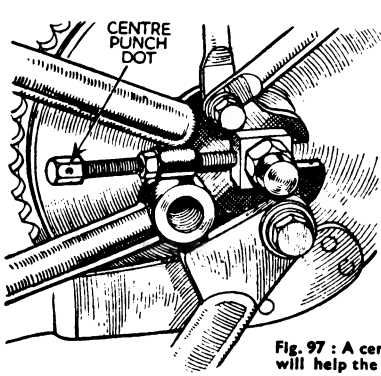


Fig. 97 : A centre punch dot on each chain adjuster will help the owner to remember how much each screw has been rotated

So far only the steering of solo motor cycles has been discussed. Now let us turn to questions affecting sidecar outfits.

When the average man fits a sidecar to a solo he lines it up,

screws down his steering damper to the degree that seems best, and leaves it at that. The steering that results will probably be passable, but not superb. Unfortunately, the steering layout that is best for a solo machine is not ideal for sidecar work, and as a solo *has* to steer properly, and it does not matter vitally what the steering is like on a sidecar machine, obviously all motor cycles, unless produced specifically for use with a sidecar, are designed with solo-type steering.

There is, however, little reason why a sidecarrist should remain content with having to manhandle his outfit round bends or constantly keep his arms braced to prevent an incipient wobble. It is possible to produce a sidecar machine that handles with almost all the ease of a solo.

Castor Action

The most important matter when a sidecar is fitted to a solo is to reduce the trail of the front forks, or, in other words, the castor action. For sheer lightness in steering the scheme is to have no trail at all. There is then no pull on corners and none as a result of road camber, but such a layout is only suitable for the sidecar driver of immense experience, since you cannot feel the sidecar at all and therefore cannot tell whether, on a left-hand bend, the wheel is about to lift. This means that the driver has to judge his speed on bends to perfection and has nothing to tell him whether he is going too fast. And suddenly he may decide that the sidecar *is* lifting and pull wildly over to the right.

At the other extreme we have the heavy-steering solo, with its excessive trail, turned into a sidecar machine. If the sidecar is a wide one it will be found to be just about all you can do to lug the outfit round a bend. The thing is to strike a happy mean—no centre-point business, and none of your solo trails, but something between the two, and the best as a general rule is a trail of one and a half inches. This is shown in Fig. 98.

Few realise that it is quite a simple matter to alter the trail. If you look at Fig. 98 again you will note that the trail is automatically reduced if either shorter

top fork links or longer bottom links are fitted in place of those shown. Many manufacturers supply special links for this very purpose ; if your particular maker cannot, it is easy enough to have a pair that give a one and a half inch trail made up. The cost will be infinitesimal compared with the benefit that will be derived.

In the illustration a rake of 64 degrees is shown. To obtain this, of course, means structural alterations. However, this is not imperative, and it is only included because it happens to be the rake that a well-known manufacturer has found after a number of experiments to be the most suitable for sidecar work.

Sidecar Alignment

Next we come to the question of sidecar alignment. The first point is the position of the sidecar axle relative to the rear-wheel spindle. Opinions differ as to the distance the axle tube should be in front. The manufacturer who makes probably *the* best steering outfit maintains that it should not be more than one inch ; another who knows practically all there is to be known about sidecar steering says that it should be an inch to an inch and a half. All that can be said is that if you arrange that the distance is not more than two inches you will be reasonably right, but if it is less so much the better, for, according to experiments, there will be less drag on the right-hand bends.

As every sidecar driver knows, the sidecar wheel should point inwards towards the front wheel of the machine. Various

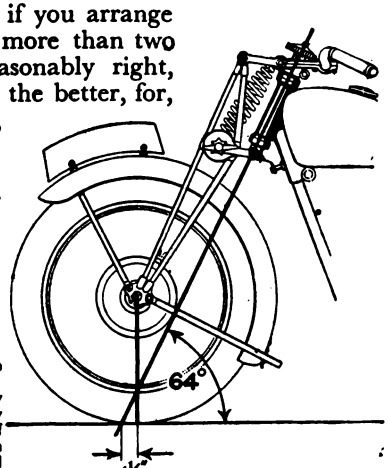


Fig. 98: The angle or rake of the steering head—64 degrees in this particular instance—cannot be readily altered but it is generally quite easy to fit fork links that give a trail of 1½ in. ; this trail, which is shown on the right, will usually be found to give excellent sidecar steering

people advise various amounts, but if there is too much toeing-in the sidecar tyre will wear badly and there will be a tendency for the machine to lift if right-hand bends are taken at speed. Fig. 99 shows the amount that will be found to be just about ideal.

Lastly, on this question of alignment, is the matter of the amount the machine should lean outwards, away from the sidecar. If there is too much lean there will be a tendency for the outfit to crab on right-hand bends, and, of course, the greater the lean the more trouble one has in getting back on to one's own side after overtaking another vehicle on a much-cambered road. Some people believe in an outward lean of as much as one and a half inches, measured at the top of the steering head. Probably an inch is about the best with a medium-weight sidecar of average width. The distance should be measured with a plumb-bob—a nut on the end of a piece of string can be used.

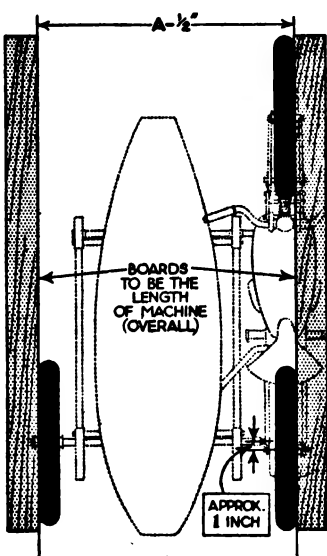


Fig. 99 : For the best sidecar steering the sidecar wheel should toe-in half an inch (i.e., distance A, minus ½ in.) and the axle tube of the chassis be set approximately one inch in front of the rear wheel spindle

That covers all the points in connection with alignment, but bear in mind the need for lining up the outfit on an absolutely level floor and with the aid of boards that really have a straight edge.

As many realise, the sidecar has a big influence upon the steering. If the body has a heavy nose and/or the front springs are mounted some distance back, the steering will never be superb—the body will plunge about and affect it.

Finally, we have the question of sidecar width. Obviously, the wider a sidecar, and the lower its centre of gravity, the less the tendency for it to lift on left-hand bends. But the narrow outfit is lighter to handle and also gives better rear-wheel grip ; these are two of the reasons why ultra-narrow chassis are usual for trials work, but for normal work extreme narrowness should be avoided.

CHAPTER 27

SKIDS AND SKIDDING

Sound Front Tyres : Ribbed Treads : The Brakes : Clutch Action : Transmission : Carburation : Carrying Luggage

OUR previous subject, " Good Steering ", and that of skids and skidding are closely allied. You cannot expect freedom from skids with a solo unless (1) the wheels are in line ; (2) there is no backlash in the hub, fork and steering head bearings ; and (3) the riding position is a comfortable one that ensures proper control. Few skids are experienced in these days of good-steering, low-centre-of-gravity machines, and probably half of those that do occur could have been prevented by a little work in the garage.

The three points in the previous chapter just mentioned are all matters to be attended to in the garage. They were considered very fully, so will not be discussed here. Equally important is the question of tyres. First and foremost, it must be realised that to change over the tyres, fitting the worn rear tyre on the front wheel, is utter folly. Rear-wheel skids are easily corrected, whereas front-wheel ones aren't.

If the front and rear tyres are the same size, the front cover can be put on one side as soon as it shows signs of wear and kept for use later on the rear wheel. It is, however, false economy as well as folly to have a worn front tyre. Not only is there the question of peace of mind, but one toss may easily mean writing off the foot-rests and brake pedal and cause far more expense than the cost of a new tyre.

Incidentally, people often remark that they use up their partially worn-out tyres during the summer. Those who adopt this practice forget that roads are at their skiddiest when there is a shower following a dry spell,

because, through lack of rain, oil drippings and other skid-provoking slime have not been washed away.

In road racing, as has already been mentioned, the ribbed front tyre is practically universal. In the opinion of many, apart from improving the machine's steering, it is a definite preventative of front-wheel slides. It is, however, no good in soggy mud, which straightway fills in the ribs and gives the effect of a dead smooth tyre, and some riders dislike it on tramlines, though others greatly prefer it, because they find they can take the lines at a big angle and then straighten up with a feeling of complete confidence.

Board-hard tyres tend to beget skids, so the pressure should be tested and not guessed. The majority of experienced riders generally run at somewhere near the recommended pressures, using the particular combination—front and rear—that experiment seems to denote as being best, but when the roads are slithery often they go down on these by a couple of pounds or so. Care, however, must be taken to avoid running the front tyre *too* soft, for this means that the sides of the tread will be ground away, and it is the sides that hold you—or drop you !—when it comes to skidding.

The next matter concerns the brakes, which must be smooth and progressive in their action. Any harshness must be eradicated, and if the front brake is in any way inefficient it should be seen to, because the important brake on greasy roads is not the rear one but that in the front. How to look after brakes and cure their little shortcomings is discussed in the very next chapter, so we need not go into the matter here.

Like the brakes, the clutch should be sweet in operation. If it is harsh the reason, as a rule, is that the dogged projections on the plates are not sliding freely in the slots in the clutch housing (Fig. 100). This trouble occurs with both new and old machines. In the case of the former there may be some burring, while with the latter wear is the cause.

The cure is to dismantle the clutch (keeping the plates in their correct order) and remove any roughness from the

projections and from their slots. A fine file and, finally, emery cloth should be used. Care is necessary because if more metal is removed from one projection than the others that particular projection will not press home against the side of its slot and therefore will be doing no work When it comes to reassembly, smear the grooves with just a trace of graphite grease or H.M.P. grease and make certain that the tongues do really go into the grooves in which they were originally working.

An aid to smooth clutch operation is to have the control wire so adjusted that the handlebar lever, when the clutch is starting to grip is in the best possible position for delicate manipulation.

Smooth transmission, which is the subject of Chapter 32, is important from the skidding aspect, and so is the adjustment of the carburetter. The mixture must be " clean ", so that the carburetter opens up smoothly, and there must be no play either in the throttle control or its operating cable.

One final word on the skidding question ; if you are carrying luggage, see that it is strapped so that it cannot flop about; the best straps for motor cyclists' use are the webbing ones—they never slack off and there are no holes and therefore there is no difficulty about getting the straps properly tightened up.

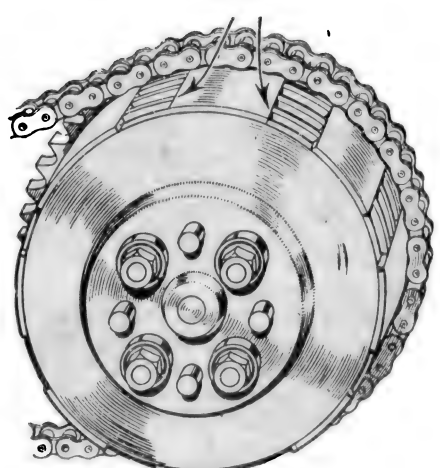


Fig. 100: Harsh clutch operation is often caused by the plates not sliding freely. This may be due to burring in the case of a new machine or wear when the machine is elderly

CHAPTER 28

PERFECT BRAKES

Adjustment : Lubrication : " High Spots " : Scored Drums : The Brake Cam Leverage

GOOD brakes spell good averages ; they also ensure safety and peace of mind. Tuning the brakes is quite as important as tuning the engine—some would say " more important "—but the majority of people, except for adjusting them occasionally and relining them when they become totally inadequate, take their brakes for granted.

The remedy for poor braking is often in the rider's hands.

The first point with any brakes is to see that they are correctly adjusted. This is obvious, but the usual advice to the effect that the brakes should be so adjusted that, when in the off position, they just do not bind is not always best.

They must not bind when off, of course, but, with the front brake control, for instance, it is highly desirable that there be a certain amount of slack in the cable so that the brake does not go on when the fingers are out-stretched, but when the fist is partially clenched. This is because one cannot obtain proper leverage and smooth, progressive braking with fingers stretched right out. But—and it is a big BUT—the control wire must never be so slack that there is a chance of the ferrules at the ends of the cable slipping out of their sockets.

Then, as regards the rear brake, often, with the brake rod or cable adjusted right up, the pedal goes on in a position that does not enable the foot to press on it properly. Slackening the adjustment may help here, and it may also be desirable to alter the brake stop—usually not a difficult thing to do.

No leverage must be lost, and it is important that all

the sliding parts in the operating mechanism work freely. The front cable should be well greased at the time of fitting and lubricated regularly, while any exposed portion should, for preference, be not only greased but protected by being enclosed in a piece of rubber tubing.

The spindle of the pedal, the pins in the yoke ends, and all other bearings in the control mechanism, should be kept properly lubricated. Where cables are employed, frictional losses can be avoided by seeing that the cables run in easy sweeps—no sharp bends, and the outer casings undamaged.

Lubricating the Cam Spindles

Lubrication is also necessary for the cam spindles. For this grease nipples or oil holes are frequently provided. Only a little lubricant should be supplied, of course, otherwise it may find its way on to the linings and render the brakes inoperative, or almost so. Where no means of lubrication are arranged, the cam spindles should be removed at least once a year, washed in paraffin—or polished with fine emery cloth if rusty—their housings cleaned out, and the whole lot smeared with graphite grease previous to reassembly. The cams themselves should be cleaned up and lightly greased, together with the thrust ends of the brake shoes.

At the same time all dirt should be removed from the drums and the linings examined. It may be found that the heads of the rivets are level with, or protruding fractionally above, the surface of the linings, thus preventing the linings from gripping properly. If so, the rivets should be tapped farther into the linings and then clenched over afresh.

Examination may also reveal that certain portions of the linings are bedding down on the drums, while others are not. In other words, there are high spots and, just as is the case with a piston that has high spots, a little attention is necessary with a file—in this instance a fairly coarse one.

Only the high spots should be eased, of course, and, to obtain brake shoes that bed down really perfectly,

the scheme is to attend to the linings in this way on several occasions—that is, until they do really bed down over the maximum possible area.

Some riders make a practice of roughening their linings with a rasp. This fluffing-out the surface is usually undesirable, and it is better to scrub the linings with a stiff nail-brush dipped in clean petrol. This is the scheme if there are any signs of grease or oil. Never steep the linings in petrol and set fire to them, because, if the linings are of the type interwoven with fine brass wire, the wire will fuse and that will be that.

Obviously, if lubricant is to be prevented from reaching the linings, the hubs must never be overfilled. Experience has taught some riders to be a little distrustful of the the grease nipples to be found screwed into the hubs, since the grease, if supplied in small quantities, may stick in the middle of the hub an inch or more from the point where it is wanted, and, when provided in large quantities, may find its way through the brake-side bearing and on to the linings. For this reason, they prefer not to use the greasers, but to dismantle the hubs occasionally and pack the bearings, using a stiff hub lubricant.

A fact about wheel bearings which is not sufficiently widely known is that any excessive slack will mean that the brake drum does not run true ; consequently the braking will be harsh, and probably poor as well.

Scored Brake Drums

Brake drums, if badly scored, can never do their job properly. Some clever amateurs have skimmed up their worn rear brake drums by removing the brake shoes, running the engine and applying a suitable cutting tool to the drum. For accuracy it is generally best to have either the drum skimmed up by the makers or a new one fitted.

Relining brakes is fully covered in the book, *The Motor Cyclist's Workshop*. There is, however, one point which should be stressed : harshness in brake operation, while it may be caused by dirt, scored drums and incorrectly adjusted wheel bearings, will often result if the leading

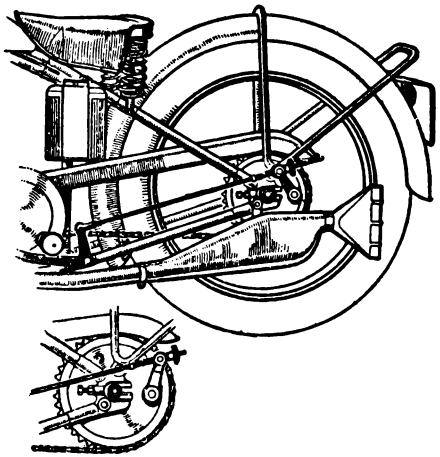


Fig. 101: Efficiency is lost once the linings wear to such an extent that the cam lever passes the dead centre position when the brake goes on, as is the case illustrated in the larger of the two drawings. The brake should begin to bite when the lever is approximately in the position shown in the lower drawing

edge of the brake lining is not chamfered off (see Fig. 93). It will be realised that where there is no chamfer there is a tendency for the lining to ruck up and jam.

Often riders who experience poor braking examine their linings and find they look all right—no signs of oil, and there appears plenty of lining left. In such cases the trouble may be merely that the cam lever has passed the dead centre position as shown in Fig. 101. The brake should by rights begin to come on when the cam lever is roughly in the position indicated in the smaller of the two drawings. When it is found that the lever is past the dead centre position when the brake goes on, the time has come either for new linings or for packing the brake cam. Some brakes have detachable ends to their shoes, so that the rider can insert shims (i.e., packing washers), thus obtaining further use from the linings—either this, or maybe there are serrations on the cam lever and the cam spindle, so that the lever can be moved round in relation to the spindle.

Little need be said regarding interconnected brakes and their adjustment. It is widely known that the action of applying the brakes is to transfer increased weight

to the front wheel, and that, as a result, when riding in a straight line, one can use the front brake really hard without fear of locking the wheel. But, because of the undesirability of applying the front brake hard when the machine is banked over, some users of inter-connected brakes prefer not to rely on the pedal for all their braking ; instead, they adjust the brakes so that the pedal merely assists the hand operation, and they use their hands and feet together, utilising the hand lever to a degree depending upon the circumstances of the moment.

Assisting the hand control in this way is of considerable value, but, where the brakes are independently operated it is always as well to have a really big leverage for the front brake. This, if not provided as standard can be accomplished by replacing the handlebar lever with one that is much longer, or by brazing an extension piece on the lever. Using a lever with a straight pull is, of course, most desirable. With many brakes a simple scheme for making them more powerful and lighter in operation is to fit a longer brake cam lever.

CHAPTER 29

THE CARE OF TYRES

Practical Hints on Securing Long Life and Efficient Service

IF there is one job in which the average motor cyclist of to-day is inexperienced it is in the repair of tyres. That old-time bogy, tyre trouble, is almost non-existent. For this we have to thank modern tyres, modern road surfaces, the dearth of the hobnailed boot, the decrease in the number of horses that use the roads, and a small host of other things, not excluding the larger tyres that are now fitted as standard. All the same, it is desirable to know something about the care of tyres and, more especially, how to overcome trouble when our luck is out.

Accompanying every new machine are instructions as to how wired-on tyres should be removed and refitted and as to the correct pressures for the different wheels. Removal is as simple as A B C—always provided that the tyre is reasonably accessible. The points to remember are that the tube must be completely deflated and the wall that is to be removed must be pressed right home in the well (Fig. 102) except in the immediate vicinity of the valve. Press the wall into the well at the part diametrically opposite the valve; then insert a tyre lever three or four inches from the valve, and with this lever in position go round the tyre with a second lever, pushing the wall into the well. This done, the tyre wall will come away even with the aid merely of fingers.

If removal is a struggle don't use mighty levers and brute force—the cause of the trouble is certain to be that you have failed to bear in mind one or other of the two essential points, unless the machine is a racing job and the wells are fitted with well-fillers, in which case the

well-fillers have, of course, to be pulled out of position before the wall can go home in the well.

Refitting, perhaps, causes rather more difficulty, though only in the matter of getting the valve home in its hole. Probably the best practice here is to push the two walls over to the far side—that is, away from the side at which one is working—and, after thrusting the valve in its hole, to inveigle the necessary wall over to its correct side of the rim. People with small hands, however, may find that it is easier to lift up the wall and manœuvre the valve in between the rim and the cover.

The old dodge of pumping up the tube which one used to adopt in the case of beaded-edge covers is liable to cause trouble when applied to the wired-on type. Slight pumping—once the valve has been fitted in place, with the accent upon the word "slight"—is an aid in the insertion of the tube in the cover, since it prevents the tube being twisted, and also has the result of tending to keep the tube out of harm's way.

The only other point is the obvious one that when refitting a tyre one starts at the part opposite to the valve and works round in both directions so that the valve portion is fitted last.

Pressures are important, since, unless security bolts are fitted, the only thing that keeps the cover in position is the air pressure in the tube. Too low a pressure, in addition to causing a waste of power and rapid tyre wear and aiding and abetting concussion bursts and fractured walls, is liable to result in the valves pulling out of their tubes.

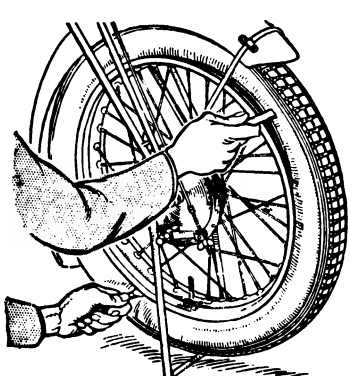


Fig 102 : The essential in tyre removal is to get the wall of the cover home in the rim well

The question of tyre pressures is all-important

if satisfactory service is to be obtained from the tyres, and those who get poor tyre mileage have, in nine cases out of ten, only themselves to blame. The reason is their failure to maintain the correct pressures, and/or their driving methods.

With the cross-sections that are fitted as standard to-day there is little excuse for using pressures other than those the tyre makers recommend. A variation of a pound or so is permissible, and may actually prove desirable. When riding over treacherously slimy city streets it is distinctly preferable for the tyres to be on the soft side, and the same applies when a freak hill with a slippery surface has to be tackled, but the tyres should be pumped up afterwards. Otherwise the pressures should never be varied appreciably from those that are specified, unless it has been found by experiment that slight alterations improve the machine's road-holding.

As a direct result of this care, the sides of the tread will never be ground away, leaving the middle portion more or less intact—the sure sign that the tyres have been run under-inflated.

Check Pressures Weekly

Once a week is not too often to check off the pressures, and the man who does this and duly makes any necessary corrections will save time, money and trouble in the form of punctures and concussion bursts. He will obtain better tyre mileages, and by avoiding unnecessary power losses will even save a percentage on his fuel bill!

It almost goes without saying that the tyres must run truly and be in line so far as the front and the back are concerned. The first point means that the rims must not be buckled, and that the rubber line moulded on the side of each cover, on the wall, must be at an equal distance from the rim all the way round; this should be carefully checked every time a cover is refitted. Correction is affected by partially deflating the tube and pressing the walls in the required direction.

Where a sidecar outfit is concerned, obviously the alignment must be correct (Chapter 26).

In these days of plunger-type valves there is no chance of a tyre deflating through a faulty valve, provided that the little rubber capsule inside the valve cap is intact. After a time the rubber either perishes or becomes cut through by the end of the valve housing. The cap should be replaced just as soon as a ring-like indentation appears in the capsule, and in any case once a year. Given this attention, plus screwing on the cap finger-tight, the valve will never leak, for the capsule itself makes everything airtight.

Plunger Replacement

Valve plungers, too, should be replaced about once a year. If the tyre pump is given one or two strokes before being attached to the valve, almost all chance of grit finding its way on to the valve or its seat and preventing the plunger from seating will be obviated. Should the plunger stick and be found to be letting the air out of the tube on the removal of the pump connection, quickly waggle the end of the plunger with the little spanner that forms the top of the valve cap (Fig. 103) ; this will generally free the plunger and cause it to seat correctly.

Assuming this proper maintenance of the valve, the deflation of a tyre is almost certain to be due to either a puncture or a concussion burst, which means that the fabric of the cover has given way on the inside and either chafed through the tube or nipped it. Because of the possibility of a concussion burst or of a nail or tin-tack protruding through the cover, it is highly desirable to examine the inside of the cover most minutely before the inner tube is finally replaced. When one reads in a trial report that So-and-so had

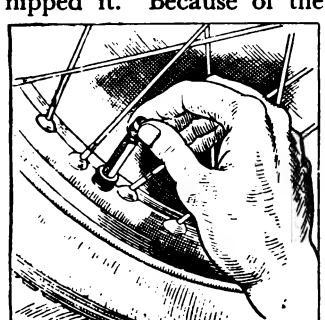


Fig 103: A sticking valve plunger can generally be freed with the aid of the little spanner on the valve cap

a succession of punctures one can be almost sure that he had either one puncture or one concussion burst and in his hurry never spotted and overcame the cause.

One concussion burst, unfortunately, may put paid to a cover—hence *do* be careful about those pressures !—though it is often possible to make a tyre carry on for thousands of miles by inserting and carefully solutioning in position a canvas tyre gaiter, which is an excellent thing to carry on a lengthy tour. Another method—a temporary one—is to stick a rubber patch over the portion of the fabric that has burst.

Many experienced riders believe firmly in the strip type of patching rubber for repairing inner tubes, preferring it to the cut patch. One big advantage is that you can cut from the sheet the exact shape of patch that you want.

Long slits are the nastiest repairs to effect, because the split tends gradually to become longer and longer. The dodge in this connection is to cut a neat circular hole at each end of the split so that it can't extend. In the case of bad gash, a good scheme is to fix a patch on the inside of the tube as well as one on the outside. If there is a really serious hole it may be as well to use an intermediate patch that just fills the hole, and prevent any serious air pocket between the inner and outer patches.

Sometimes a nail will make a messy sort of gash-plus-tear. In such a case it is often a wise plan to tidy up the hole with a pair of scissors.

Now a few brief final points. First, the patch should be cut so that it overlaps the hole by roughly $\frac{3}{8}$in. all the way round and has rounded corners. Secondly, a gash in the tread rubber spells the entry of water, and therefore should be cleaned out and filled with tyre stopping such as is to be found in some repair outfits and is also available from accessory concerns. Thirdly, rust on the inside of a rim will damage a tyre. Fourthly, see that no spoke ends protrude. Fifthly, *do* allow the solution time to become tacky before applying the patch. Sixth and lastly, remember that if the solution has been left at home petrol will often do the trick.

CHAPTER 30

DECARBONISATION

Lifting the Head : Gudgeon Pins : The Rings : Piston Crowns : Use of Caustic Soda : Polishing

DECARBONISATION is one of those tasks that are taken for granted. All the average instruction book says on the subject is, " Remove the carbon ", which is hardly helpful. Of course, the job is simple, but the methods that can be adopted are both many and various and good and bad.

Most instruction books give plenty of information on the question of stripping the engine and state how often it should be decarbonised. Two or three points need stressing, however. First, there is the matter of detaching the cylinder head from the cylinder barrel, that is, assuming the head, as is usual nowadays, is detachable.

In no circumstances should a screwdriver blade or any sort of wedge be tapped into the joint, since damage will result. Removing the fixing screws or nuts and tapping the exhaust ports in an upward direction with a rawhide or wooden mallet is also a bad scheme. It is all too easy to do considerable damage by such means—ports may be broken off, fins sheared and induction stubs bent oval. Assuming common sense—light taps on heads with plenty of metal in them—there is no great danger, but the safest method is to slack off each of the fixings a couple of turns and kick the engine over compression. This will generally free the parts all right, always assuming the sparking plug has not been removed !

The various nuts or screws should be placed in a tin and, for preference, arranged so that each will be fitted on (or in) the particular threads from which it was removed.

If a cylinder-head gasket is fitted to the engine, it should be scrapped if damaged in any way. Otherwise it should be pulled off very carefully to ensure that it is not

bent, and put on one side in such a position that when the time comes there will be no doubt as to which way up and which way round it was fitted originally.

Gudgeon pins in these days are usually held in position by spring rings or, to use the standard term, circlips. A pair of small pliers forms the easiest means of squeezing their ears together and pulling them out. Normally, only one circlip need be removed and if it is remembered which one is removed, there will be no question as to which way round the piston should be refitted. Otherwise it will be necessary to mark the *inside* of the piston skirt with, say, an " F " for " Front " in order to ensure that the piston is not turned round through 180 degrees.

Refitting the piston correctly is important, because otherwise it will present new bearing surfaces to the cylinder walls and have to accommodate itself afresh. Indelible pencil or the tang of a file can be used for marking the inside of the skirt.

Removing the Gudgeon Pin

Normally, once a circlip has been removed the gudgeon pin can be pushed out from the opposite end, while, if there are soft end-pads on the gudgeon pin and, therefore, no circlips, it is also a case of pushing out the pin. Occasionally there is some special fixing for the gudgeon pin, but this point is practically certain to be covered in the maker's instruction book.

Should the pin not push out easily, do not tap it, since a bent connecting rod may result. Instead, wrap a rag steeped in boiling water around the piston, which, provided it is of light alloy, will generally expand sufficiently to free the pin. If this dodge does not do the

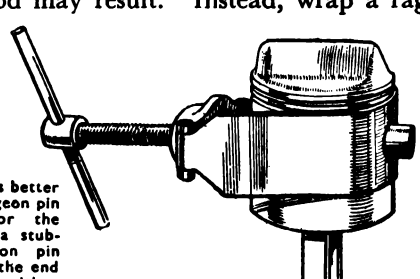


Fig. 104 : It is better to use a gudgeon pin extractor for the removal of a stubborn gudgeon pin than to tap the end of the pin with a copper drift

trick, a gudgeon-pin extractor, such as is illustrated in Fig. 104, should be employed.

The time-honoured method of removing piston rings is to use three narrow strips of tin and slip them, one after the other, under the end of the ring that is to be removed. Push the strips around the piston until they are equally spaced out, and slide off the ring. Another method is to peel off the rings one by one with a knife blade used in much the same way as one would peel an apple. This is a sound scheme, but not so safe for an amateur as the strips of tin method. It is, however, useful when it comes to a question of removing a gummed-up ring on a two-stroke piston, though for this a little tool specially made for the purpose by the house of Terry is generally safer (see page 203). Where the recalcitrant ring is one fitted to a cast-iron piston, it can easily be freed by the use of caustic soda solution, of which more in a minute or two.

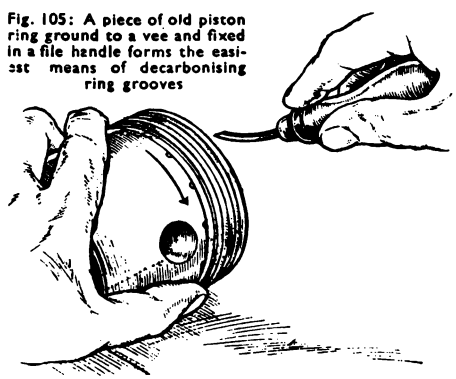


Fig. 105: A piece of old piston ring ground to a vee and fixed in a file handle forms the easiest means of decarbonising ring grooves

For cleaning out the ring grooves there is nothing to equal an old piece of piston-ring with its end ground to a vee. Fig. 105 shows the tool in use. The piston is rested on the bench and rolled against the tool, which, of course, should not be allowed to dig in.

Carbon adhering to the back of the piston rings is left in place by many riders. They believe—and it appears from tests that they are right—that it is as well not to disturb piston rings that are bedding down properly. Thus, unless the bearing surfaces of the rings are discoloured (in which case replacements are necessary) they do not touch the rings—not even to remove the carbon

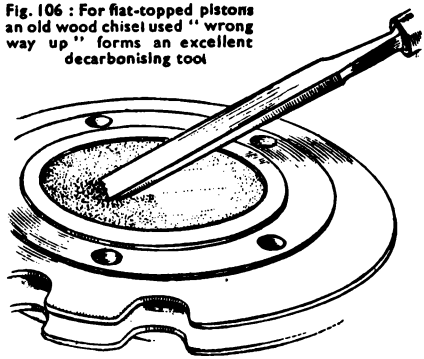


Fig. 106 : For flat-topped pistons an old wood chisel used "wrong way up" forms an excellent decarbonising tool

from the grooves—but, once they have satisfied themselves that the rings are bright all round, replace the cylinder.

Removal of carbon from a piston crown can be tackled in many ways. The usual scheme is to scrape off the deposit with a knife blade or a wood chisel. But when the piston is of light alloy, almost invariably this results in the piston crown being scratched, and the more scratched it becomes the greater the tenacity with which carbon will adhere in future.

Assuming the piston crown to be highly polished, the carbon will flake off with tapping. The edge of a wood chisel blade can be used for this, but, unless the method is employed with care, the soft aluminium alloy will be bruised. An excellent scheme is to use an eight- or ten-inch stick of ordinary tinman's solder, which is triangular in cross section, quite heavy and considerably softer than any piston alloy.

If the piston crown is tapped at an angle with a series of glancing blows, and the piston crown has been well polished and the carbon is hard, the carbon will come away in big flakes, leaving undamaged the polished surface underneath. Soft rag and metal polish will then remove any slight discoloration.

Another good plan is to hammer the end of a stick of solder into the shape of a chisel and use this as a scraper. The alternative to these methods is very careful scraping with a chisel or a knife with a rigid blade.

Whatever the method, the piston crown should eventually be polished to a mirror-like finish, so that future decarbonisation may be really easy. Any blemishes on the piston crown can be removed with very fine emery cloth.

Sometimes, with pistons that have large clearances, considerable carbon will be found adhering to the top land, i.e., the portion immediately above the top piston ring. This carbon normally does more good than harm, and, if smooth, is best left in position.

When an engine has a detachable head and a flat-top piston, a wood chisel, used as is shown in Fig. 106, is generally about the best means of removing the carbon. Naturally, care must be taken to avoid allowing the chisel point to dig in. Use the chisel "wrong way up" and keep the sharp edge canted upward to that it just clears the piston surface.

Caustic Soda

For cast-iron pistons the easiest method of decarbonisation is to use caustic soda solution. It is also the simplest for cast-iron cylinder heads, but in no circumstances must it be used for aluminium parts and only very weak in the case of aluminium-bronze. The method is one that has been mentioned in *The Motor Cycle* time and again. All one does is to buy a few pounds of caustic soda from one's ironmongers, procure a five-gallon oil drum and cut off the top or obtain an old galvanized bucket, and put in the caustic soda, followed by hot water. Three pounds per gallon is enough for cast iron (up to 1 lb. per 3 gallons for aluminium-bronze).

Then, without splashing the solution into your face, and preferably not putting your hands in it, drop the cylinder or piston in the solution. Leave it overnight, and the following morning remove it and wash it really thoroughly in running water. The chances are that every speck of carbon has peeled off. But the washing must be thorough, and, since caustic soda removes every trace of oil, the cylinder bore should be wiped dry and smeared with lubricant, while it is also desirable to anoint the fins with cylinder black.

For high-speed decarbonisation the solution should be used hot. It need not be thrown away, since it can be employed again and again.

One advantage of the scheme is that the solution will decarbonise inaccessible parts such as the inside of the

piston crown of a two-stroke, which would otherwise have to be scraped with a screwdriver blade. Incidentally, a screwdriver is more useful as a scraping instrument if the blade is heated to a dull red and the end bent over slightly.

Where the caustic method is not employed, cylinder heads must be decarbonised by scraping with a chisel, screwdriver or a bent knife blade—use a knife with a fixed handle. Care must be taken not to scratch the valve seats or the ground surface of the head joint.

For the small recess around the valve seats probably the most suitable tool is a bradawl.

Cylinders with non-detachable heads can, as a rule, be decarbonised most readily by chipping.

For this a long screwdriver and a mallet are the chief tools. The final work can be accomplished with hand work, scraping off the carbon with screwdriver, preferably one with the end of the blade bent over. Obviously, one must be careful to avoid scratching the cylinder bore.

Polishing the Head

Wherever possible, the head should be polished. This is best accomplished with fine emery cloth. This is also useful for the crowns of cast-iron pistons, for valve ports and valve heads. The radius on valve heads should first be scraped carefully with a knife and then polished with emery. Here real care is necessary or the valve faces will be scratched. For valve ports and two-stroke ports the best tools are an old bearing scraper and a scraper made from an old triangular file.

Next there is that little matter of grinding-in the valves. This task savours of donkey work and, therefore, is all too frequently skimped. There is, however, only one way to tackle it, and that is painstakingly, since upon the gastight fit of the valves depends the keen edge of engine performance. Valves that seat badly mean poor starting, high fuel consumption, second-rate pulling on hills, bad idling and, in extreme cases, overheating.

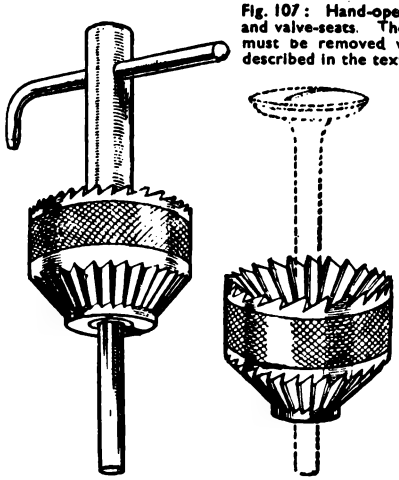


Fig. 107: Hand-operated cutters for truing up valves and valve-seats. The surface hardness of the valve face must be removed with emery cloth (in the manner described in the text) before the cutter is used

The best scheme is to grind-in the exhaust valves first. There may not be quite the same zest when we come to the inlets !

If the exhausts have deep pock-marks, do not grind them in on their seats. This results in the seats in the cylinder or head being ground away unnecessarily. And valves pocketed through excessive grinding-in cause reduced power, hot running and a sluggish performance generally. When a valve is pocketed the effective valve lift is reduced, and the only remedies are to have the metal that is shrouding the seat cut away by a competent mechanic or to have new valve seats fitted.

Assuming that although the seats are not pocketed the exhaust valves are badly pitted, it is best to have the valves refaced. Cutters of the type illustrated in Figure 107 can be employed, but as this is an infrequent job, and the tool expensive, generally the best scheme is to get a good local garage to skim up the valve faces. A shilling per valve is the most you are likely to be charged.

One method of cleaning up the valve face without wearing away the seat is to cut a square of emery cloth, thread the valve stem through a hole in the middle of this square with the business side of the emery towards the valve head and, pressing the head home on its seat, work the valve to and fro. Figure 108 illustrates the scheme, which, provided the square of emery cloth is replaced with a fresh one after a minute or two's work,

will soon clean up the valve face. The results are not exactly perfection, and a fair amount of grinding-in afterwards is generally necessary. When a valve cutter of the type shown in Figure 107 is used, the surface hardness of the valve face should first be removed by the square-of-emery method.

Many engines have valves with slots milled in their heads so that grinding-in may be accomplished with the aid of a screwdriver. Where this is not the case, some tool for gripping the valve stems is required. A tap wrench is often used for this purpose. Another tool consists of a small, stout tube slightly larger in internal diameter than the valve-stem diameter, with a set screw or clip at one end for gripping the valve stem and a tommy bar at the other. Both tools are effective if they are well tightened up, but the former has the objection of being liable to damage the valve stem. One of the best tools is that shown in Figure 109. This, as will be seen, incorporates a pair of split collets which fit in the relieved part of the valve stem and hold the stem absolutely rigid.

Where a screwdriver is used a good plan is to place a light spring underneath the valve head, so that when the pressure on the valve is released the valve springs upward.

The golden rules in valve grinding are: (1) distribute the grinding paste on the valve face evenly yet sparingly (the finger is best for this), and (2) avoid rocking the valve head sideways—this applies more especially in cases where there is considerable play between the valve stem and its guide.

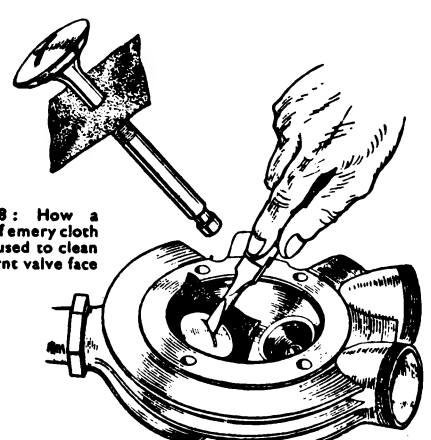


Fig. 108: How a square of emery cloth may be used to clean up a burnt valve face

In these days the use of ready-mixed valve grinding paste is the normal practice. Dual tins that contain two grades of paste, "coarse" and "fine", are available. Sometimes the carborundum or emery powder sinks to the bottom of the tin, leaving almost plain grease at the top. If this is suspected, a little gentle stirring with a nail or tommy bar is desirable.

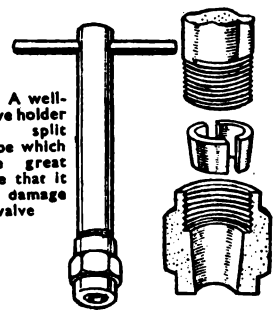


Fig. 109: A well-made valve holder of the split collet type which has the great advantage that it does not damage the valve

Then smear the face of the valve all round, fit the valve in place, place the screwdriver in its slot or fix on the special tool and, keeping an even direct pressure on the valve (or pull, as the case may be), rotate the valve a third of a turn one way and an equal amount the other way. Continue this oscillatory motion half a dozen times; then lift up the valve, turn it round a third of a revolution and proceed as before. Every now and then redistribute the grinding paste or remove the used paste and apply fresh. Carry on until both the seat and face are bright over the whole of the surfaces. Then remove the coarse paste from the valve and the seat with a petrolly rag and finish off with light grinding and the fine paste.

Some riders are satisfied so long as there is a bright ring round both seat and face, but a valve which is in contact with its seat over the whole of the available area is preferable. Others rotate their valves instead of oscillating them, but this has the objection that the grinding paste may cut rings in the valve face, which will give the impression that it is seating perfectly whereas actually it is doing nothing of the sort.

Finally, the valves and the valve seats must be washed really thoroughly with petrol to remove every speck of abrasive.

Now we have really come to the point when the engine can be reassembled. First, the valves must be replaced,

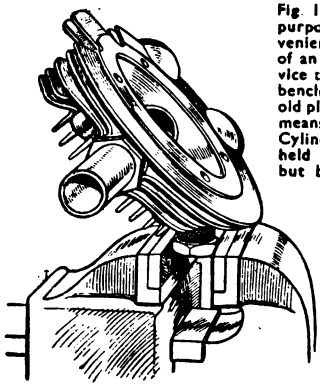


Fig. 110: For grinding-in purposes it is more convenient to mount the head of an o.h.v. engine in the vice than to rest it on the bench. The body of an old plug forms the simplest means of fixing the head. Cylinders should not be held directly in the vice, but bolted to a wooden base plate

but before sliding them home smear their stems with either good graphite grease or a high-melting-point grease. Valve springs are cheap and make quite a useful difference to engine performance, so fit new ones or, at all events, new exhaust springs. The valves have been washed after being ground in, so presumably their fixings are free from grit. In any case, wash the collar and cotters or collets.

Next, wipe out the little-end bush, making certain that its oil hole is clean, and wash the piston and gudgeon pin. Also wash the rings. Then refit them and, after smearing the gudgeon pin with oil, replace the piston.

There is little point in being careful to arrange the piston rings so that their slots are spaced absolutely equally around the piston, but with a hot-stuff engine, if the rings have been touched, it is as well that the slot in the top ring is away from the sparking plug.

Next wash out the cylinder barrel with petrol and, when it is dry, lightly smear the whole of the cylinder bore with engine oil. Then, after seeing that the cylinder-base washer is clean and intact and smearing it with oil or a jointing compound, slide the cylinder over the piston, compressing each ring in turn with your fingers as you do so.

The surfaces of the head joint must be spotlessly clean, and the fixing studs tightened up evenly. The studs should be rotated until they just grip and then be given a sixth of a turn each, working not round the head but diagonally across it, until all are tight; since a cylinder head tends to bed down, go over the studs again after, say, the first fifty miles.

CHAPTER 31

FITTING PISTON RINGS

The Old Rings : Testing a New Ring for Fit : Checking the Gap : When New Rings are Needed

ONE blessing about the modern piston ring is that, being narrow, it does not need lapping in. When a new ring has to be fitted, more often than not it is merely necessary to clean out the groove and slide the ring over the piston into position.

Sometimes, however, the job is *not* quite so easy as this ; the old ring is, perhaps, " gummed " in position or the new one will not fit properly. If the old ring is gummed in place, as occurs now and then on some elderly two-strokes there are three possible lines of action. The first—the lazy method—is to lever the ring out with the aid of, say, a bradawl, breaking it into pieces in the process. Piston rings are cheap and, since the new ring, as has been mentioned, will bed down quite happily of its own accord, no great harm is done. When a ring is well-nigh solid with the piston and the latter is of aluminium, it is really not worth while to do other than adopt this scheme, for it saves trouble and temper, and the possibility of damaging the groove or the neighbouring piston lands.

Should cast iron be the piston material there is a very simple means of freeing the ring without causing any damage, and that is by leaving the piston overnight in caustic soda solution (see the previous chapter). This will remove the carbon that is gluing the ring in position and, except for the necessary very thorough washing in running water, all will be well. Another scheme, which applies to both aluminium and cast iron pistons, is to use ammonia or methylated spirits.

Finally, there is the peeling method. This is a slow process, and one that requires both care and patience.

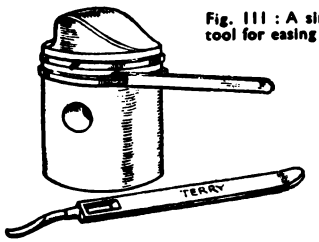


Fig. 111 : A simple but effective tool for easing stuck piston rings

Either the little tool illustrated in Fig. 111 should be used or the ring should be peeled with a penknife as in Fig. 112. You may smash the ring, but even so, except for the time and trouble, you are no worse off than would have been the case had the first method been adopted. The ring should be " worked " a little at a time and, if the piston is of aluminium, care is needed not to scratch the lands.

Very occasionally there are instances where, owing to the rider forgetting to fill up with oil or " blinding " a new engine, the piston dries up and in the process some of the metal forming the ring lands is dragged over the rings. This does not necessarily mean that the piston must be scrapped. Much can often be done by breaking out the ring and then cleaning up the groove with a fine file, though it is better, of course, to have the groove trued up in a lathe by a competent mechanic.

Testing for Width

So much for removing rings. Chapter 30 covers the subject of cleaning out the grooves with a tool fashioned from an old piece of piston ring and a bradawl handle. We can therefore pass on to the actual fitting of a new ring. The first job is to roll the ring round the groove which it is to fit to make sure that it will go in (Fig. 113). A normal type of piston ring should have 2 to 3 thousandths of an inch up and down movement.

If it is too wide it must be eased down.

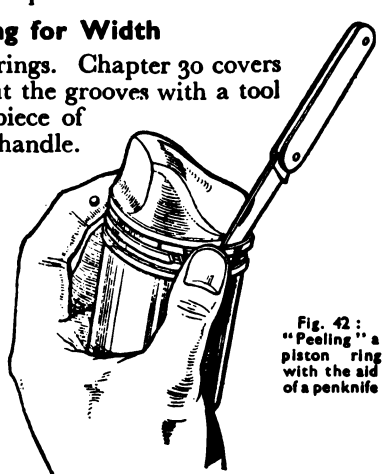


Fig. 42 : " Peeling " a piston ring with the aid of a penknife

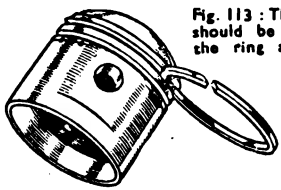


Fig. 113 : The fit of a new ring should be tested by rolling the ring around its groove

This is quite a simple task. The necessary "tools" are a piece of glass—for preference, plate glass, since this is of a high degree of accuracy, whereas the glass often used for window panes is not—and a nice new sheet of emery cloth. Lay the emery flat on the plate glass and rub down the ring by pressing it evenly downwards with the fingers and moving the fingers with a rotary motion (Fig. 114). Since the accuracy will not be of the same high degree as that of the original manufacture, the rubbing down is best confined to one side only. Needless to say the emery cloth should not be of a coarse variety, and it is desirable to finish off with a really fine grade, such as "blue-back".

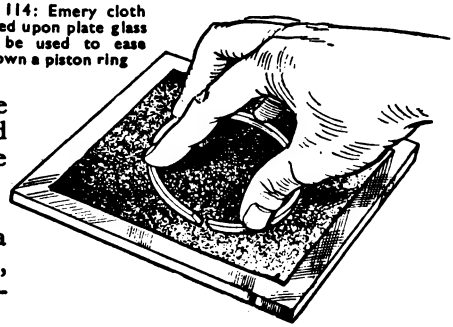


Fig. 114: Emery cloth placed upon plate glass can be used to ease down a piston ring

Having eased down the ring so that it is now of the correct width for the groove, the next task is to check the gap between its two ends. For this we have to insert it absolutely truly in the cylinder bore—not right at the end of the bore, but at a part that the rings actually traverse when the engine is operating.

There is one simple and accurate way of ensuring that the ring is really inserted truly, and that is to push the piston up the cylinder barrel and then slide the ring up the bore until it is pressing evenly against the base of the piston skirt. Next, without disturbing the ring, move the piston up the bore until it is comfortably out of the way and test the gap between the two ends of the ring. This is accomplished by means of feeler gauges, which are obtainable

from garages and tool shops at round about 2s. 6d. a set. The width of the gap is, of course, equal to the thickness of the particular feeler gauge that will just slide into the gap without disturbing the ends of the ring.

The instruction book issued with the machine is almost certain to say what the gap should be ; if it happens to be less than the amount stated, one end of the ring must be filed until tests prove that the gap has been increased to the required dimension. A small, fine file should be used and care must be taken to keep the ends of the ring parallel.

Should the gap be made too large by mistake, this will not be very serious because it is far better to have the gap too large than to have it on the small side. When the gap of a ring is too small and the engine heats up, the two ends of the ring will start pressing one against the other owing to expansion ; this, in turn, will mean that the ring presses hard on the cylinder bore—perhaps so hard that the engine will seize. Therefore, it is much better to err on the side of too large a gap, and whenever an engine comes down, the ends of each ring should show a light coating of carbon ; if the ends are bright, or there are bright areas of metal showing through, it is apparent that the ends have been butting up against one another and the gap must, therefore, be increased.

Replacing the Rings

There is little else to be said about the actual fitting of piston rings, except to point out that it is desirable always to replace the rings in their correct grooves and the same way up that they were originally. With the standard form of scraper ring the bevelled side should be uppermost.

A question which many novices ask is, " How can I tell when new piston rings are required? " The answer is quite simple. A ring is all right if, first, the surface it presents to the cylinder walls is bright over the whole of its area—that is, there are no black or even slightly discoloured portions—and, secondly, the gap between its ends is not more than three times that recommended by the engine makers as correct. Some people refer to " loss of

spring ", but where this occurs there will be gas leakage —blowing that will cause discoloration of the ring.

There is no great point in being careful to arrange that the ring gaps are equally spaced around the piston. Rings, other than the pegged rings of a two-stroke, have a habit of not staying in the positions in which they are arranged, so all that there is to do is to see that the gap of the top one is not arranged so as to be alongside the sparking plug, and then to avoid having the others with their gaps dead in line with the top one.

CHAPTER 32

THE CYCLE PARTS

Hub and Steering Head Bearings : Chains, Shock Absorber and Sprockets

"BALL bearings do not require lubrication ; what they need is protection from damp and grit, and that is what the lubricant provides."

That remark is surprising ; it is, of course, a bit of an exaggeration, but not very wide of the mark—what ball bearings do most emphatically require is protection.

Cycle parts are important from the steering aspect—you cannot have good steering if the hub, steering head or front fork bearings are faulty. They also have a by-no-means negligible effect upon the maximum speed of the machine. This last point does not matter very much to the average man ; what is far more important from his angle is that they should give lasting service and do their job properly.

More hub and steering-head bearing failures are caused by incorrect methods of adjustment than by anything else. This is essentially a job that requires care and patience. Let us consider the adjustment of a steering head stage by stage as an example of the methods that should be employed with all ball bearings that are adjustable.

We have found by "rolling" the front wheel backwards (Fig. 115) (in the manner described in Chapter 26) that there is slight backlash between the head clip and the top of the steering head? Right! To take this up, we first slacken the bolt that fixes the head clip and secondly rotate the big hexagon nut immediately above the head clip. Many people screw down this nut until it locks up solid and then slack it back a fraction. This is the method that should *not* be adopted. You know how

a child can raise a car with a jack—a jack with a coarse-threaded screw ; well, imagine the pressure set up between the balls (or rollers) and their races, when the finely threaded nut on the head stem is tightened up. The result is that the balls or rollers are squashed and, even if nothing fractures, there is a big chance of small indentations being made in the races and the balls themselves suffering. And once this occurs the bearing and the steering will deteriorate.

No, the correct method is to turn the nut only a fraction ; then tighten everything up and test whether all is well, repeating the dose until the adjustment is dead right. To test the adjustment, first adopt the rolling method to check that there is no backlash and, secondly, raise the front wheel clear of the ground, by mounting the crank case on bricks or a suitable box, and see that the bars swing round perfectly freely.

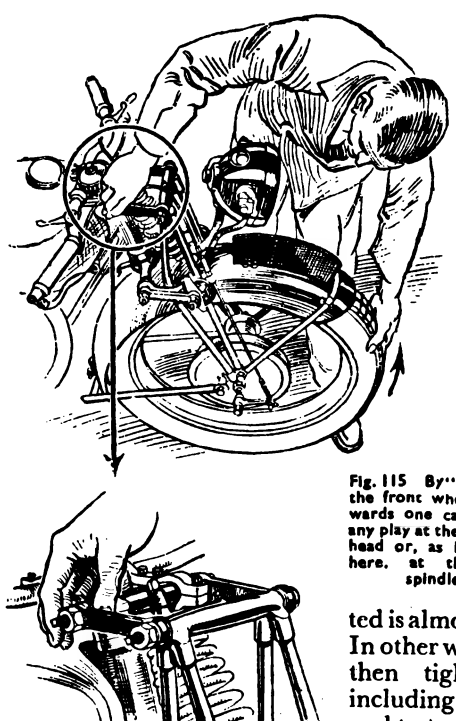


Fig. 115 By "rolling" the front wheel backwards one can detect any play at the steering head or, as is shown here, at the fork spindles

With a wheel bearing of the adjustable type the method to be adopted is almost exactly the same. In other words, adjust a trifle, then tighten everything—including the spindle nuts—and test ; adjust and test, and

so on. Once again let us stress the essential need for this "little at a time" business. By pressing the rim sideways, with the fork blade members as steadies for the hands, one can detect even the most minute fraction of side-play. Remember that the play, if any, invariably seems large.

With ball bearings the ideal is a wheel that spins with complete freedom yet has no backlash at the rim. In the case of taper-roller hub bearings, the wheel should spin, but there must be the tiniest fraction of side-play—about a sixty-fourth of an inch—at the rim; this is essential, since otherwise serious trouble will ensue—possibly complete failure of the hub bearings.

Roughness in the Bearing

If, when a steering head is correctly adjusted as regards play, the bars swing with a feeling of roughness or, in the case of a hub bearing, the wheel will not spin, the trouble is due to one of four things: first, there may be grit in the bearings; secondly, the bearings may be pitted; thirdly, the races may not be right home in their housings; or, fourthly, a roller or ball, as the case may be, has perhaps fractured.

A broken ball or roller in a hub bearing normally makes a clicking noise when the wheel is revolved.

If the rough feeling has only been noticeable recently we can rule out point No. 3. In any case, the bearing must be stripped and the various parts washed in petrol, when any pitting will be discernible with ease. If the balls or rollers are pitted, yet the races seem reasonably good, fit a completely new bearing. It will pay in the long run, for the races cannot be really sound if the balls or rollers are faulty. The price of new bearings is not a very big item, and, as has been stated before, the wheel and head bearings have a big effect on the steering and handling of a machine.

Some riders who find, say, a solitary broken ball replace it with a nice, bright new one in an endeavour to economise. But the probability is that the new ball is fractionally larger than the old ones and therefore, will have to with-

stand more than its fair load ; as a result it will damage the races and, quite possibly, break up.

An old race in, say, the steering head or hub can generally be tapped out with a long rod of copper or brass (steel may damage the housing) inserted in the other end of the head or hub. Always wash out the housing carefully with petrol and see that there is no grit or fluff either in the housing or on the race that will prevent the latter being pressed right home. The word is " press " because tapping with a rawhide mallet or copper hammer may tend to force the race in at an angle and distort it. When a race cannot be pressed home with the fingers it is generally a simple matter to fit it with the aid of a bolt a little longer than the head (or hub), and a couple of washers, one for each end.

This dodge can also be adopted with the non-adjustable ball bearings to be found in certain hubs.

New wheel and steering-head bearings tend to bed down a trifle, so their adjustment should be checked after the machine has covered its first run.

Fitting the Balls

When fitting the balls in a cup-and-cone bearing, the standard method is, of course, to smear the cup with vaseline or a good quality grease and press the balls into the grease, which will hold them safely in position while the remaining parts are assembled. One point to watch in this type of bearing is that too many balls are not inserted. There should be a certain amount of gap between the balls when they are right home. Sometimes it is possible even to squeeze in one more—don't ! The best plan, as a rule, is to count the number of balls when stripping the parts and make a note of it ready for the time of reassembly.

On some machines grease nipples are provided on the steering head. If this is so, once every three or four months use them to force in fresh grease and drive out the old grit-laden lubricant. Otherwise it is advisable occasionally to smear grease in the crack between the head and the head stem members to prevent grit finding

its way straight into the bearings. It is also desirable, say, once a year, to strip the head, wash out the bearings and repack them with grease.

Hubs are generally provided with a grease nipple mounted in the middle. Pump in grease and, usually, it just stays in the middle of the hub, where it does precisely nothing ; pump in a lot and it will go through the bearings and into the brake !

Happily, as mentioned at the outset, the chief requirement of the bearings is not lubrication but protection. Therefore, many riders forget all about the rather stupid little grease nipple and every five thousand miles wash out the bearings and repack them with high-melting-point grease.

The Fork Spindles

Now, finally, we come to the question of the fork spindles. In an earlier chapter mention was made of the need for taking up any side-play just as soon as it develops. The point for discussion now is the prevention of wear at the fork spindles. Here there are usually grease nipples that really do their job unless too-thick grease or a poor grease that tends to solidify is employed. If all is well the grease will squelch out at both ends of the spindle. If it does not do so the spindle must be removed, cleaned with petrol, and, if necessary, emery cloth, the housing cleaned out "pull-through" fashion and the spindle, nicely greased, replaced. Don't put off this job from one month's end to another, or the steering will suffer and the cure—new parts—is costly.

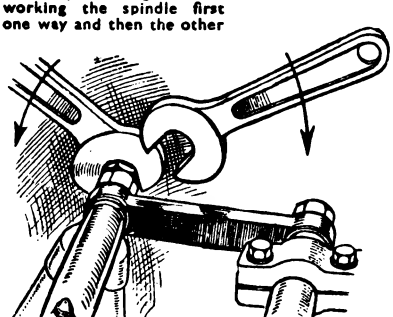


Fig. 116 : Sometimes a seized fork spindle can be freed by locking together two nuts on the protruding end and working the spindle first one way and then the other

Usually the spindle can be tapped out with a copper or brass rod, but if it has seized solid it will be best to remove the grease

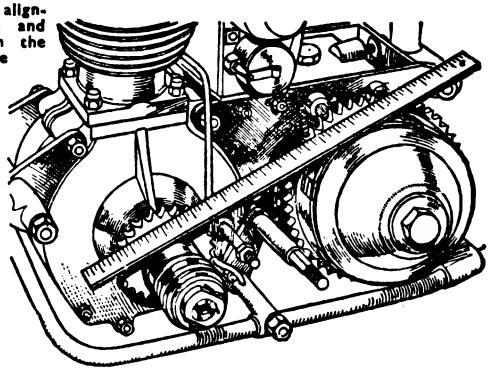


Fig. 117 : Checking the alignment of the engine and clutch sprockets with the aid of a straight-edge

nipple, scrape out the old grease in its hole and pour in penetrating oil. Top up with penetrating oil over, say, a period of twenty-four hours, and then try tapping. If nothing happens, don't hammer away and strain the forks, but (if the spindle has no hexagonal head) see whether two not-too-thick nuts can be locked together on one end and the spindle started by working it first one way and then the other (Fig. 116) : this will help the penetrating oil to do its job.

That old saying about backlash spelling wear probably applies more to the transmission of a motor cycle than to any other part. If a chain is allowed to run " sloppy " it " flings ", and a hundred miles of this will mean more wear at its bearings and of its sprockets than a thousand miles of proper usage.

A little trouble over the maintenance, and the life of the transmission will be doubled or trebled ; and as the primary of a five-hundred may cost 12s. 6d., the secondary over £1, and the sprockets and rear chain wheel well over £3, it will be realised that the matter is one that seriously affects one's pocket. Added to this, a harsh, flapping drive is good for neither the gear box nor the engine bearings.

The three essentials with chain drive are : (1) correct alignment of the sprockets, (2) adequate lubrication, and (3) proper adjustment. Unless the machine has been piled up or something funny has happened to the gear box or engine bearings, the alignment of the primary chain is likely to be perfect. It can be rough-checked

quite easily with a straight-edge in the manner shown in Figure 117. The rear chain alignment is the one more likely to be out, since this is automatically thrown out in the event of one chain adjuster being rotated more than the other. But if the wheel alignment is correct the chances are that the alignment of the rear chain is also all right, so the first thing is to check up the wheel alignment in the manner described in "Good Steering" (Chapter 26), and make sure that the wheel spindle is right home in its fork ends.

Generally, by removing the chain guard and standing behind the rear mudguard, one can sight along the rear chain and see if there is any question of malalignment. In the case of second-hand machines one may find incorrect hub assembly upsetting the alignment, or wear in the rubber-buffer-type cush hub causing the rear chain to wriggle. Correct alignment, although important, is far from being universal on second-hand machines.

Repairing Chains

Lubrication and adjustment were fully considered in Chapter 24; therefore, little need be said here. There is, however, the question of repairing chains. Here it must be remembered that fitting a new length in an old chain is folly, since the new will be unworn and the old will probably be very worn. Obviously the chain, as a result, will be alternately slack and tight—wear will be rapid and the drive will be harsh. If for reasons of economy an old

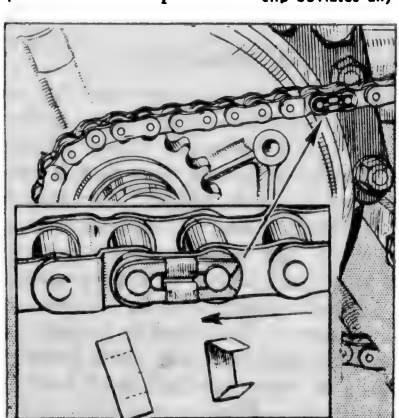


Fig. 118: A piece of thin tin wrapped around the spring clip obviates any chance of the clip coming adrift

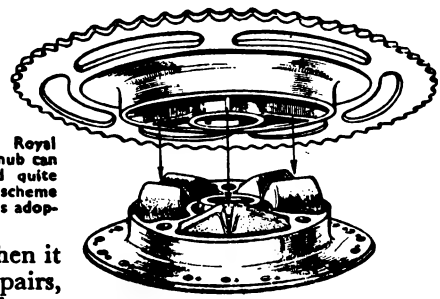


Fig. 119: A Royal Enfield cush hub can be assembled quite easily if the scheme shown here is adopted

chain must be patched up, try to find another piece of chain that is equally worn. A rivet extractor saves time and temper when it comes to chain repairs, but do buy a good one and never leave it to clatter about in the toolbag or in a very short time it will be useless.

Some riders, when joining two pieces of chain, rivet up the joint, so that they need only use one spring link, but unless one has the correct riveting punches the work is generally slipshod and the link quite likely to let one down. In such a case it is better by far to use a second spring link. Of course, the spring clips on these links should always be fitted so that their closed ends point in the direction of the chain travel. Those who dislike the thought of a second spring link should adopt the old trials dodge of wrapping a strip of thin tin around the spring clip (Fig. 118).

Transmission Shock Absorbers

Transmission shock-absorbers can be mounted in one or more of three places. Some machines have spring-loaded cam-type dampers on the engine shaft; others rely solely on a rubber-buffer affair in the clutch and others, still, have rubber-buffer cush hubs. The rubber type require no attention other than the replacement of the rubber blocks when they age and backlash sets in. With the Royal Enfield cush hub there is a very simple method of refitting the vaned chain wheel; if you do not know it the task is a teaser. The plan is to put the blocks in position in the hub member and then arrange each pair so that the blocks cant upward and have a vee-shaped gap between them. Figure 119 shows the

arrangement more clearly than any words. It is then only necessary to place the vanes in the vees and press the chain wheel home.

Lubrication, periodical cleaning of the sliding surfaces and correct reassembly are the chief points to bear in mind in connection with cam-type shock-absorbers. These matters, however, were discussed in considerable detail in Chapter 24. How a clutch may be harsh owing to the tongues on their plates not sliding freely in their grooves has also been considered (Chapter 27). A point in this connection is that serious wear of the tongues and grooves need not necessarily mean expensive replacements. Often one can find a welding firm which, for merely a few shillings, will build up the old parts and either complete the task or leave to you the cleaning up afterwards with a file—which must, of course, be done carefully. Remove too much metal and the good work is undone ! Not only that, but all the load will go on one or two tongues.

Worn Sprockets

Sprockets whose teeth have worn to a hooked formation should be scrapped on the score of economy. They ruin a good chain. If you have any doubt as to whether a sprocket *is* badly worn—it is not so easy as might be thought for the inexperienced to be certain on this point —remove a roller from a piece of chain of the same size as is fitted and place this between a pair of teeth. Does it fit snugly or not ? If it does *not* and there is considerable space when it is pushed towards the more rearward of the two teeth, then serious wear has taken place. Another method of checking roughly is to wrap a piece of new chain around the sprocket and pull on each end alternately.

Where chains are concerned, the following is a simple, effective means of determining the amount of wear. First, wash the chain in paraffin to remove the grease and road grit. Then place the chain on a flat, smooth surface, such as that afforded by a piece of board, and alternately pull and push on its ends. If there is more than

a quarter inch total end movement per foot, the chain should be scrapped.

The method to adopt in the removal of a sprocket depends upon the particular design. With an engine sprocket which has no special withdrawal device incorporated, the best plan is to use the three-prong type of sprocket drawer (Fig. 120). Where no sprocket drawer is available, the jarring method described in *The Motor Cyclist's Workshop* may be employed.

In the case of the nut fixing a gear box sprocket, either mount the gear box in the vice, wrap a piece of chain round the sprocket and nail the chain to the bench, or leave the gear box in position with the chain on and get a friend to keep the rear brake hard on ; then use a set spanner that really fits and start the nut by tapping the set spanner.

A matter in which many motor cyclists seem to be surprisingly (and expensively) negligent is that of tightening up sprocket- and flywheel-retaining nuts. The nut must be jarred up dead tight by tapping the set spanner. Should a sprocket or flywheel that is held on a plain taper slip it is practically certain that the shaft will be damaged, and further slipping will occur unless the tapers are machined up again or new parts fitted. Prior to assembly, the surfaces that are to mate must be wiped absolutely clean ; they should, of course, be fitted dry.

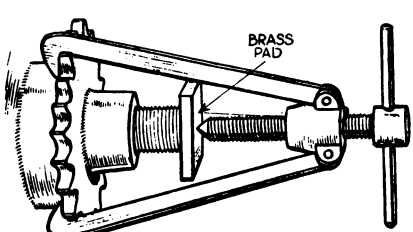


Fig. 120 : A three-prong type of sprocket drawer is the best means of removing a sprocket which has no special withdrawal device

CHAPTER 33

THE MAGNETO

Maintenance Hints : How to Strip it

TROUBLE with a magneto is rare in these days. About the worst that seems to happen is that the heel of the rocker arm on a new contact-breaker beds down a trifle and causes the gap at the points to decrease, or that the contact-breaker cam ring tends to stick.

Contact-breakers vary in construction quite considerably. There are, however, only two main types produced in recent years. Fig. 121 shows the rocker-arm type, and Fig. 122 the face-cam type. The former, as will be seen, employs a bow spring for closing the platinum points, while the latter has a flat spring blade. To remove the former type of contact-breaker, unscrew the hexagon in the centre—the central stud—and, after withdrawing it part way, gently waggle it from side to side ; this will free the contact-breaker on its tapers and the breaker will then " come away in your hand ".

Remove the Spring First

This done, undo the set-screw fixing one end of the bow-spring, taking care that the screw does not fly off into thin air. Always remove the spring before prising off the rocker arm ; this is important, because otherwise the spring will be twisted. Then polish the pin on which the arm pivots. The striking surface of a safety-match box will do this as well as anything ; as an alternative, " blue-

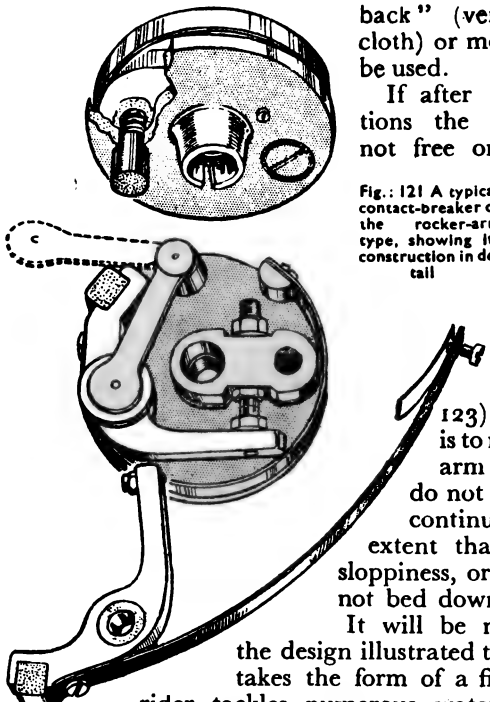


Fig.: 121 A typical contact-breaker of the rocker-arm type, showing its construction in detail

back" (very fine emery cloth) or metal polish can be used.

If after these ministrations the rocker arm is not free on its pivot, the fibre bush must be eased out with sandpaper wrapped round a small bolt, or even a matchstick (Fig. 123). All one wants is to make the rocker arm perfectly free; do not be brutal and continue to such an extent that there is any sloppiness, or the points will not bed down perfectly.

It will be noticed that in the design illustrated the cam follower takes the form of a fibre pad. If a rider tackles numerous watersplashes it is

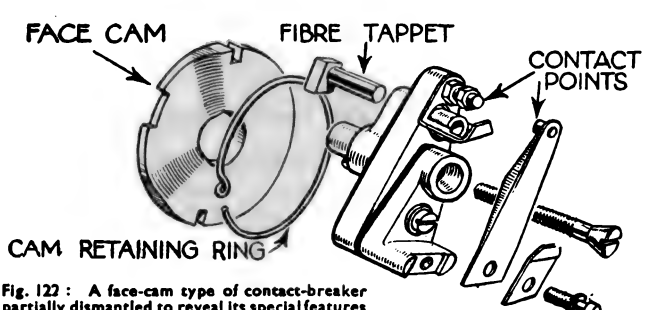


Fig. 122: A face-cam type of contact-breaker partially dismantled to reveal its special features

possible for this pad to swell considerably ; a trace of vaseline will help to prevent wear and the absorption of water.

On the face-cam type of breaker (Fig. 122) the cam follower consists of a rod which at one time was of hygroscopic material and, owing to swelling, could lead one some lovely dances. It is not a bad idea with this type to run with the rod slightly greasy.

The Gap at the Points

Emphasis has been laid upon the importance of maintaining the correct gap at the platinum points on the score of easy starting. All the same, do not tinker with the gap needlessly, since it is much better for the points not to have to bed down afresh. A little thought will show that, owing to the action of the rocker arm an alteration to the adjustment in the case of any but a new instrument is almost certain to mean that the points, in the closed position, no longer bed down properly. The recommendation with the majority of magnetos is that the gap at the points, when they are fully open, shall be twelve thousandths of an inch ; provided that the magneto is functioning properly there is no need to worry if the adjustment is one or two thousandths out.

The essentials are that the points shall be clean, free from pitting and bed down truly. Where really necessary, the points, if of platinum, should be filed very carefully with either a proper magneto file or a really fine nail file.

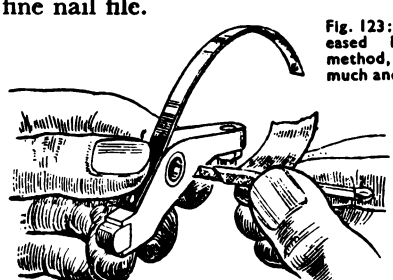


Fig. 123: When the rocker-arm bush is being eased by the sandpaper-and-matchstick method, care must be taken not to remove too much and thereby make the bush a sloppy fit

This is rather delicate work, and any lack of care may easily result in the points being ruined. Owing to the difficulty of ensuring that the points bed

down over the whole or their area, as some recommend, many riders adopt the scheme of filing the points so that they are slightly convex or domed, as is the case with new magnetos. This helps the points to bed down of their own accord, but the scheme should not be carried to excess, because the platinum tips are only thin and readily filed right through.

This filing is finicky work if the points are to be true, so, after a short bout of filing, test the accuracy of your craftsmanship rather than go blindly ahead. When checking place a piece of white paper behind the points and use a strong light, and remember that it is no use looking at the contacts from one direction only—that one view may show everything to be in order whereas, say, an end elevation may reveal that the filing has all been at an angle.

Many file the contacts with the rocker arm in position, but the careful man will make a better job of it if he detaches the rocker arm for the actual filing and takes the trouble of checking off frequently. If there is a black patch in the middle of each point the probability is that the points have burnt through and sparking is occurring between the steel of the screws to which the platinum tips are welded. There is only one thing to be done in such a case and that is to purchase a new pair of points. The recommendation here is to fit platinum if the particular instrument is turned out with platinum as standard.

Tungsten must be Ground

Tungsten points, which are provided on many modern magnetos, are too hard for filing and therefore must be ground. A carborundum slip or emery cloth tacked to a strip of wood will do the trick. Where this type of point has a greyish appearance the points should be polished up with the aid of fine valve-grinding paste, which should, of course, be carefully wiped away afterwards.

When, finally, the rocker arm is replaced in position, smear the pivot with the merest trace of vaseline or some other first-class grease ; use only a trace, since contact-

Fig. 124 : A magneto partially dismantled to show the various components. The important points which the rider can and should see to are : (1) the cleanliness of the slip ring ; (2) that the carbon brush is clean and slides freely in its holder ; (3) that the holder is not cracked ; (4) that the earthing brush behind the contact-breaker is clean and the surface on which it runs free from dirt ; and (5)—see insets—that the platinum points open to their correct gap, close properly, are clean, and bed down squarely

breaker points take strong objection to grease in any form. Nor, incidentally, should petrol ever be allowed to reach them. For washing them, use methylated spirits.

As with tappet adjustment, the tightening of the lock-nut on the adjustable point is liable to cause an appreciable alteration in the setting, so the gap at the points should be carefully checked when everything is properly tightened up.

A contact-breaker is a built-up job ; therefore, when it is off for overhaul it should be examined to make sure that the pad held by a screw, and any other detachable parts, are firmly fixed.

One last item before we pass on to consider how a magneto should be stripped. The earth brush at the back of the contact-breaker, while a magneto will function without it, is a desirable feature, since, if it were not there the current would have to return via the ball bearings supporting the armature ; therefore, see that it is free in its housing, that the path on which it runs is clean, and that it has the nice polish on its end that shows it is bearing correctly.

Stripping a Magneto

Stripping a magneto is quite simple ; some might say that it is *too* simple, since the very simplicity of the task is liable to tempt the novice to pull his magneto to pieces unnecessarily, and in doing so cause serious damage.

However, magnetos have to be stripped every now and then. Every ten thousand miles, according to the instruction books, they should be dismantled to have their bearings repacked with grease and—a point not mentioned in these books—one sometimes comes across a case where oil has a habit of finding its way into the armature tunnel and short-circuiting the h.t. current.

As a rule, if oil is finding its way into the magneto, one is safe in assuming that the breather valve in the crank case is choked up or for some other reason not operating properly. Sometimes, when the timing-side main bearing becomes sloppy, the breather ceases to do its job in the way it should, the pressure relieving itself

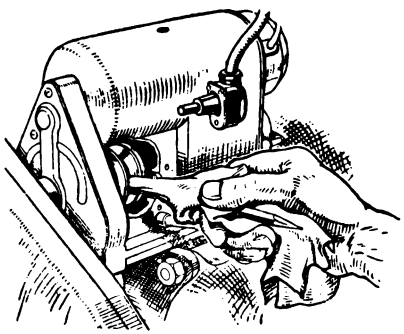


Fig. 125 : Oil and dust should be removed from the slip ring with the aid of a rag moistened with methylated spirits in the manner illustrated. The rag should be pressed against the slip ring and the magneto rotated by means of the kick-starter

by the path of least resistance—that is, via the timing chest and the hole for the magneto spindle.

The cure in either case is to make the breather function properly, assuming, of course, that the main bearing is reasonably sound. This may mean cutting a coil or two off the breather valve spring in order to reduce its strength. If the worst comes to the worst, a hole can always be drilled in the magneto chain case, so that any oil will be forced out at a safe place instead of at the armature spindle.

Before the magneto can be stripped, the driving sprocket must be removed and the instrument detached from its base. If by ill-luck this has to be done at the roadside, the chances are ten to one that a sprocket drawer of a suitable size or a withdrawing stud—if the engine incorporates this helpful feature of design—is not in the kit of spares but at home. The scheme, therefore, is to use a pair of tyre levers of the type that is to be found in the motor cycle kits of to-day. Place one each side of the sprocket and pull on their ends ; don't press on their ends, because, if you do this, the tyre levers will damage the case.

This method is, of course, only a makeshift ; and, while the vast majority of people lever off their magneto sprockets, the thoughtful man, remembering that the armature spindle is soft and supported in ball bearings, will use a withdrawing tool.

Having detached the magneto, our next tasks are to remove the contact-breaker and the carbon brush complete with its holder and the h.t. cable. Now comes the point

at which many slip up; they proceed to undo the end plate at the contact-breaker side, and forget that there is probably a safety-gap screw and possibly an earthing brush (Fig. 126). And if the set-screw that forms the safety gap is not removed previous to the end plate, there is the likelihood of the screw smashing the slip-ring—which may spell *finis* until a new slip-ring is fitted, or unless it proves possible to build up the broken part temporarily with Chatterton's compound.

Therefore, search around in the neighbourhood of the slip-ring for a stud or screw that seems to protrude into the interior, and remove it. Then see if you can find any other screw that looks as if it, too, goes into the armature tunnel. This will be the earthing brush that is to be found on certain magnetos.

Now the end-plate may be undone. If it will not pull away as soon as its fixing screws are removed, do not prise it off—this is bad for the bearings and the joint—but press on the end of the armature spindle, but in doing this beware of the armature shooting out of its tunnel. Before the armature makes its exit, precautions must be taken to prevent loss of magnetism. Remove

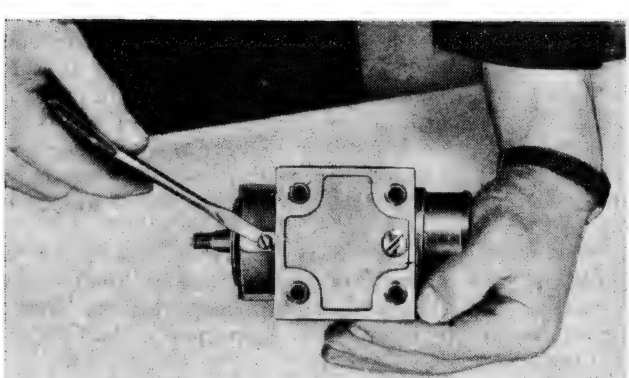


Fig. 126: It is essential to remove the safety-gap screw and any earthing brush before the armature is withdrawn, or damage will result

the armature for but an instant in the case of nearly all except some of the latest magnetos, and unless there is a keeper across the poles of the magnet, the efficiency of the magneto will be reduced ; to bring it up to par will mean that the magnet has to be remagnetised.

Some people take their bar of soft iron and lay it against the side of the magnet immediately above the armature, sliding it down as they remove the armature. Generally the best and safest method for the man who has not got some special form of keeper that goes round the magneto baseplate is to remove the magnet.

As a rule, the magnet is only held in position by one or more screws, and is, therefore, readily removed. It is perfectly easy to place the keeper across the magnet and slide it downwards as the magnet is pulled away.

Now the armature can safely be removed and any oil or grease wiped away with a piece of soft, clean rag. Wipe the slip-ring, the armature, and the tunnel. The bearings should be washed out with paraffin in order that they may be rid of any grit and of the stale grease. Then repack them with H.M.P. grease—that is, high melting-point grease. Use nothing else, or the chances are that the lubricant will melt, and that will spell trouble with a specially large " T ".

There are two other tasks which may at some time be necessary. The first is that of fitting a new condenser, which will be found ensconced in the end-plate of the armature—the one that carries the contact-breaker. The symptoms of a faulty condenser consist of heavy sparking at the contact-breaker points.

The second of the tasks that may have to be carried out is fitting new bearings. To remove the outer races heat the magneto end-plates gently over a gas burner and then tap the end-plates lightly downwards on a block of wood. If you are quick, the new races can be dropped into position before the end-plates have time to cool—otherwise they must be reheated. Be careful over removing the old inner races ; if they are pulled off at an angle their seatings will be damaged. See everything is quite clean before pressing the new ones home.

CHAPTER 34

THE BATTERY

Topping-up : The Plates : Use of a Hydrometer : The Battery Mounting

WHEN doctors disagree . . . ! The best-known manufacturers of car and motor cycle electrical equipment in this country tell you to top up your battery with distilled water—they and other makers stress *distilled* water ; and the makers of the battery fitted to the world's most famous car have stated that the idea that distilled water is necessary is a myth ! What is the ordinary motor cyclist to believe ?

Actually any water that is free from impurities is suitable. Since one does not know just how free one's own tap water is, and distilled water can be obtained quite cheaply from any garage or chemist—well, one may just as well err on the safe side and *use* distilled water.

As a guide to the proper treatment of lead-acid batteries —that is, the type of battery normally used on motor cycles —it is desirable to know a little about their construction. You will recall from Chapter 7 that there are two sets of lead plates : the positive plates and the negative ones. The positive plates are pasted with peroxide of lead, and the negative plates with pure lead. As the battery runs down, or, in other words, discharges, the sulphuric acid combines with the lead peroxide and forms lead sulphate. This goes on until, when the battery is "flat", practically all the acid is used up in forming lead sulphate and there is little more than distilled water left in the battery. When the battery is recharged the acid is forced out of the plates again. This fact is important, because the result is that we have a ready means of determining the state of charge of the battery.

Let this be put quite clearly. First, it must be borne in mind that sulphuric acid is considerably heavier than pure water. Therefore the solution will be at its heaviest when the battery is fully charged and at its lightest when

the battery is " flat ". Thus, if we determine the weight of the solution we shall know the degree to which the battery is charged. Those who have studied physics are aware that there is an easy means of finding out the density of a solution—or, in other words, its specific gravity—and that is by a simple instrument called a hydrometer. This consists of a glass syringe incorporating a small float. A small portion of the solution in the cell to be tested is drawn into the syringe, whereupon the float rises to an extent dependent upon the specific gravity of the solution, and, since the float is duly marked off in clear figures, it requires only a glance to read off what the specific gravity actually is.

The specific gravity varies to a certain extent with temperature, but at round about sixty degrees Fahrenheit the electrolyte should show roughly the following readings : fully charged, 1·280 to 1·300 ; half charged, 1·210 ; and fully discharged, 1·150.

A Good Hydrometer

A good hydrometer is indispensable to all who wish to take due care of their batteries—the word " good " needs to be emphasised since some of the cheap ones are next to useless. A sound, reliable instrument costs about 3s. 6d., and is worth it. If you have not got one already, buy one straight away and make full use of it.

From all this it will be realised how desirable it is that the battery should be readily accessible ! A hydrometer forms *the* method of determining what the state of charge is, and, therefore, the amount of charging-up that is necessary. If you do not check off regularly, and your machine is not fitted with battery-controlled charging, either you may be allowing the battery to exist in a more or less discharged state, which means that the head light will not be giving of its best and is also not conducive to the health of the battery, or you may overcharge and boil over the acid, to the detriment of the battery connections and neighbouring parts of the machine. In the case of voltage control a hydrometer is equally desirable because it reveals whether the set is working properly.

When topping up the battery, follow the maker's advice as to the height of the acid in the cells. Avoid overfilling, since this will mean that the acid, in all probability, exudes from the vents and causes damage ; and take a a little care to see that the water goes into the holes and does not swamp the tops of the cells. The hydrometer forms the easiest method of transferring the water from the bottle to the cells ; otherwise a glass or paper funnel has to be used, and this is not nearly so convenient.

Normally—that is, unless acid has been spilled or blown out through overcharging—it is only necessary to add water to the battery ; this is to make up for losses through evaporation. If, however, acid has been spilled, fresh diluted sulphuric acid of 1·285 specific gravity should be added. Use only proper accumulator acid, and if you have to dilute the acid remember that the acid should be added, little by little, to the water and *never* the water to the acid ; bear this in mind, because the latter procedure is definitely dangerous. While we are talking of danger, it should be pointed out for the benefit of the uninitiated that the gas given off from a cell is highly inflammable, so one should never use a match or other naked light for inspection purposes.

If Acid is Spilt

If at any time acid is spilled over some part of the machine prompt steps should be taken to stem its corrosive effects—it will eat away almost anything. The antidote is an alkali, and as a rule the handiest is ordinary, common-or-garden washing soda, used, of course, dissolved in water.

As might be imagined, the hydrometer reading for each cell should be much the same. If there is a marked divergence, one cell giving a reading very different from those of the others, the trouble may be that some of the acid has been spilled or leaked away, or it may be due to a short circuit between the plates, caused probably by paste dropping off the grids.

We have discussed the rectification of acid losses—that is easy—but an internal short is a very different matter. Sometimes it is possible to overcome the trouble by draining

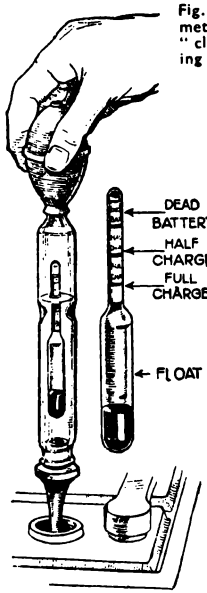


Fig. 127: A hydrometer in use, and a "close-up", showing the scale marked on the float

out the acid, turning the battery upside down and shaking hard to dislodge the bits of paste and remove them, but once paste has started to break away, that is very much that, and either a new battery must be purchased or the old one reconditioned.

The enemy of batteries is sulphation, and this occurs if they are allowed to run down and remain down. Therefore, if the battery is practically flat and the machine is not being used for a bit, have it charged up from an outside source. Never in any circumstances lay up your mount for a quarter and leave the battery to its own devices; if you do it will be only by the grace of heaven that you will find it still capable of giving good service. The battery should be fully charged at the time the machine is put away and then given a refreshing charge at least once every six weeks. With all other methods there is still a risk of sulphation.

Little need be said here concerning the battery leads (the subject is dealt with in the next chapter) except to point out that the lugs are normally "burnt-on", and any repairs in this connection should be undertaken by the maker's service station or by some other qualified battery expert. Repairs to the battery casing are also jobs for the service station. Trouble in this last connection would seldom occur were riders a little more careful over tightening up the battery fixing straps.

Look after the fixings, because if they become eaten through by acid and the battery starts floating about it is certain to be damaged, even if it does not drop off altogether!

All too frequently on old-type machines the mounting

is far from ideal, and unfortunately, from the battery's point of view, the average motor cycle has an unsprung back wheel. Should the machine be a sidecar outfit the best place is on the sidecar body, where the battery will have the benefit of the springing.

Finally, if there comes a night when your battery " blows up " and you are on a long run with a machine not fitted with voltage control, and cannot obtain a suitable spare battery, buy some 12-volt bulbs, put them in and carry on with " direct lighting ", taking care not to rev the engine hard.

CHAPTER 35

ELECTRICAL EQUIPMENT

The Wiring System : Reversed Polarity : Care of the Dynamo : The Magdyno : Focusing the Head Lamp : The Magneto Chain

PERHAPS because many motor cyclists look upon their electric lighting sets as unintelligible " boxes of tricks ", it seems to be the fashion to leave them to their own devices, and when, eventually, the sets revolt, to raise hands to heaven and curse the makers. Yet if riders would give their lighting systems a little routine attention, trouble would at least be cut in half and probably be eliminated in almost its entirety.

A considerable proportion of the failures experienced with dynamo sets is the direct result of faults in the wiring system. Little or no knowledge of electricity is necessary in the maintenance of the wiring—merely a speck of common sense. The important point is to detect faults before they have time to develop to the stage of being dangerous. This means that the wiring, which is generally flimsy, should be " vetted " regularly, and it is wise to check over the cables before setting off for any run except a short one, and, if several short ones follow each other, then roughly every five hundred miles. This applies to all riding, and not merely to night work, because chafed wires or faulty connections can result in serious trouble, even if the lights are not on. Also, every thousand miles or so, make sure that the cables have not started to fracture at the terminals on the switch. A point to bear in mind here is that if the switch is contained in the head lamp, and there is a soft metal clip to hold the wires on the inside of the lamp, the wires should be pulled taut so that they cannot shake about when, finally, the clip has been bent over them.

Obviously the cables must be arranged so that they cannot be chafed by the front forks, the steering head,

or the speedometer cable. This sometimes is not too easy in cases where the cable is of the small-diameter rubber-covered type. Something can be done with clips such as those provided for fixing Bowden cables, and also with that ever-useful material, insulating tape.

Where cable of this type is employed, it is a good plan to make the equivalent of a tube to cover the cables where they are most likely to be chafed—that is, in the neighbourhood of the steering head. This can be accomplished quite simply with a length of the specially prepared patching rubber which is provided in so many modern repair outfits and can also be purchased separately. Cut a strip long enough to cover the portion to be protected and wide enough to enwrap the cables and form a tube. Then wash the cables with a clean piece of rag steeped in petrol. When the petrol has dried off, smear the cables lightly with rubber solution and as soon as this has become tacky, carefully apply the strip of rubber. This, provided that the slight requisite care is adopted, will result in a really neat job, one that will last as long as the cables themselves.

Reinforcement at the Terminals

This patching rubber also comes in useful for preventing cables breaking off at their terminals. In this case a very narrow strip is cut, and is wound putteewise round the last three-quarters of an inch of the cable and then round the terminal post. The rubber, of course, affords an excellent springy support for the end of the wire and effectively prevents it snapping off close to the terminal. While this scheme can be adopted for many purposes—even for protecting and strengthening the join between two wires—the point at which it is often most valuable is at the electric horn, especially when the horn is mounted on the forks.

While it is desirable to keep a close watch on the whole of the wiring, the most likely causes of trouble, assuming that the cables are protected in the neighbourhood of the steering head. are, first of all, the battery connections and, secondly, the earth connection. The battery leads have

a nasty habit of corroding through unbeknown to the owner ; in cases where the leads are burnt on, acid in time creeps up the terminal post and along the wire, corroding the latter through, yet leaving the rubber casing apparently quite sound. Therefore keep the actual terminal posts well coated with vaseline, and a shrewd eye for the development of trouble.

In these days many batteries have outside terminals ; this is an excellent arrangement, particularly since when corrosion does start it is readily detected, but here again vaseline should be employed on the terminal—more especially on and around the tag at the end of the cable.

On the majority of sets the negative plates of the battery are earthed by fixing the negative lead to some convenient nut on the frame of the machine or set-screw on the engine unit, and the switch is earthed via the head lamp.

Provided that there is a perfect electrical connection between the dynamo casing, the head-lamp casing and the negative battery lead all will be well. In the case of non-voltage control sets, if there is not a perfect earth for the battery lead the lamp bulbs will burn out, while if the switch has no proper earth there is the likelihood of the polarity of the dynamo becoming reversed—in other words, of the dynamo suddenly taking it into its internal economy to charge the battery the wrong way round.

On sets where the switch is mounted in the head lamp and the lamp is on the forks it is wrong to expect the current to find its way back to earth via the fork links. The fork bearings and lamp fixings are *not* ideal electrical conductors. In such cases there should be a lead from the earthed portion of the switch or an unenamelled part of the head-lamp casing to one of the front engine fixings, or, better still, the dynamo casing itself.

Sometimes, of course, a permanent " discharge " reading on the ammeter with the dynamo charging is simply the result of the battery having been replaced the wrong way round or the battery leads having been crossed. To remedy this, put the leads the right way round. But if the polarity *has* reversed, first see that there is a proper earth wire ; then place the switch in the charge

position; start the engine, throttle down to a tick-over and, finally, hold the points of the cut-out together for a moment.

Reverting to the question of crossed battery leads for a minute, should the plus and minus marks on the battery disappear in the course of time, there is no need to dip the leads in a weak solution of vinegar or sulphuric acid and look for the bubbles that in such circumstances will appear on the negative wire. Provided that the set is fitted with an ammeter it is only necessary to connect up the battery and then, without starting up the engine, switch on the lights. If the lights go on and the ammeter shows a proper discharge, all is well.

The tags or ends of all cables must be scrupulously clean and bright, and the parts with which they are in contact must also be perfectly clean. It is no use expecting, say, the tag at the end of a negative battery lead or of the earthing cable of a sidecar lamp to transfer current via enamel. The part to which it is attached must be scraped so that a perfect metal-to-metal contact is secured.

If, owing to a broken cable or faulty earth, the lamps burn out, it is generally possible, after repairing the wiring fault, to carry on by transferring one of the bulbs from one socket to another. If the main head light was on, no doubt the main filament and the rear lamp filament have "blown". Therefore transfer the pilot bulb from the head lamp to the tail lamp, and use the dipped beam. If the pilot bulb was on, and both this and the tail lamp are no more, then use the instrument panel bulb if there is one. All the foregoing applies to old-type sets, i.e., those which are not voltage controlled.

Points about Dynamos

The two great points to remember about dynamos are (1) that, like all electrical instruments, they have a rooted objection to petrol and oil, and (2) that the positive battery lead should be removed before the dynamo is touched—with combined dynamos and magnetos there is a third point: the dynamo portion, being comparatively heavy, has considerable inertia and, therefore, rapid increases

and decreases of the engine revs, caused by blipping the throttle, are definitely bad for the drive.

Every two to three thousand miles the commutator cover should be removed and the brush gear and commutator examined and cleaned.

Before undoing the fixing of a particular brush, note whether there is some special slot in which the spring is situated. Generally on a Magdyno which has this form of spring adjustment the lowest slot provides adequate pressure and will ensure that the brush is kept properly pressed against the commutator. It may be necessary to increase the pressure as the brushes wear—this is done by moving the spring into the next slot—but in general terms it may be said that the pressure is ample if the spring causes the trigger to drop to the end of the brush box.

Do Not Pull the Brush Lead

Never try to check the spring pressure or to see whether a brush is free in its holder by pulling or flicking the lead fixed to the brush against the pressure of the spring. This may result in the lead being pulled right out of the carbon brush or the brush itself being cracked. The spring pressure must be removed before the brushes are pulled.

Remove one brush at a time, and ensure that you know which way round it was fitted so that there will be no chance of your turning it round through 180 degrees. If there is the possibility of doubt, mark their sides with a scriber or the point of a needle.

See that each brush slides perfectly freely in its box. If there are any high spots or ridges on the side of a brush, remove them with glass-paper tacked on a smooth strip of wood.

For the majority of work it is best to remove the dynamo. Of course, if the commutator is found to be coated with burnt-on carbon, complete stripping is required. Periodical dismantling is also needed in order to regrease any driving pinions and repack the ball bearings that support the armature spindle ; this should be done, say, every ten thousand miles. In the case of many of the latest dynamos there is a special, easily overlooked ball-type lubricator at the commutator end. The bearing consists of a com-

position bush with a wick around it and should receive one or two drops of light sewing-machine oil every five hundred miles.

With the majority of dynamos stripping is a far from difficult task. Some of the latest separate-type dynamos, once they

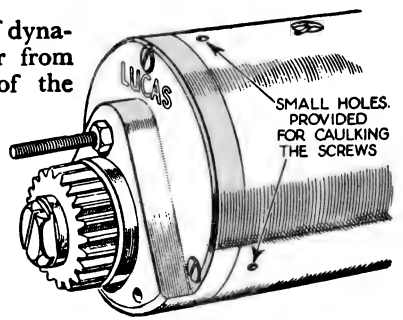


Fig. 128 : The screws that hold the end plate of old-type Lucas dynamos are locked by means of caulking, which can be removed with a drill

are off the machine, can be taken apart in little more than seconds by an experienced man. If, as already mentioned, it is not obvious as to the way in which the brushes should be fitted, they should be scratched on top with a pointed tool such as a scriber so that there shall be no possibility of them being turned round through 180 degrees and having to bed down afresh. Do not touch the business end of a brush so long as it is nicely glazed.

Where a new brush has to be bought because, say, the spring is no longer able to keep it properly pressed against the commutator, it is essential to obtain one of the correct type. The instrument should be specified, the number on it and other relevant details. The word "essential" is used purposely, and it is perhaps as well to add that in some instruments the characteristics of the negative brush differ from those of the positive. Obtaining the correct brush is important.

It is impossible to discuss the stripping of each of the many types of dynamo on the road to-day, but there are a few points of special interest and importance. In the old-type Lucas dynamo, of which there are probably a hundred thousand or more still in use, there are three long screws fixing the driving end-plate. If the exterior of the dynamo is examined it will be found that there is a small hole at right-angles to each screw. These are

provided to caulk the screws and prevent them coming undone. The caulking or burring must be gently removed with a drill before any attempt is made to undo the screws. New screws should be used when the instrument is re-assembled and these, too, should be caulked.

The latest separate-type Lucas dynamos are exceptionally easy to strip, and about the only item of note is that care must be taken to replace the locking washers correctly—this is a remark that applies to other types. Care should be taken in this direction, because there is more than one case on record in which a dynamo has come " undone ", with expensive results.

What is a problem to the unitiated is how to lock the pinions of a Lucas Magdyno in order to undo the screw fixing the dynamo pinion. The plan is to make the little diamond-shaped locking tool shown in Fig. 129. Then, if the locking tag is bent back and the screw given a square tap to break the " adhesions ", the screw can be removed

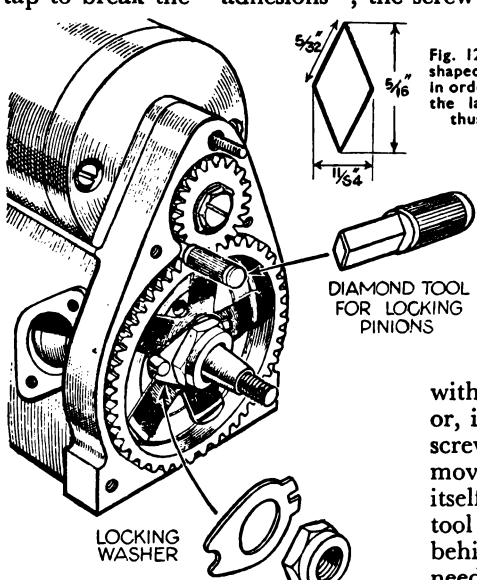


Fig. 129 : A simple diamond-shaped tool should be filed up in order to lock the pinions of the latest-type Magdyno and thus facilitate dismantling

with a set spanner, or, if care is used, a screwdriver. For removing the pinion itself a withdrawing tool that will engage behind the pinion is needed.

An endless chain is employed in the Miller Dyno-Mag. To detach the dynamo, remove the Dyno-Mag from the machine. The dynamo armature is eccentric to the body, and rotation of the instrument will slacken the chain and enable it to be removed.

Work on the commutator consists usually of just cleaning it with a piece of soft rag dipped in methylated spirits. Should the commutator be blackened—bronze-looking is quite all right—it should be cleaned with glass-paper. Wrap the paper round the commutator, which should be held in the vice, and then over-wrap it with a couple of turns of, say, ½-in. cotton tape, three or four yards long. By pulling on the ends of the tape one spins the glass-paper and at the same time exerts an even pressure. Needless to state, all traces of abrasive must afterwards be washed away with methylated spirits.

If there is carbon dust choking the grooves between the commutator segments, this should be removed by laying the not-too-sharp blade of a penknife in each slot and drawing it gently towards one. The penknife should be held so that as it is drawn forward it trails at an angle of about 45 degrees. Sometimes when a dynamo has seen much service, particularly if very harsh, unsuitable brushes have been used, the mica between the commutator seg-

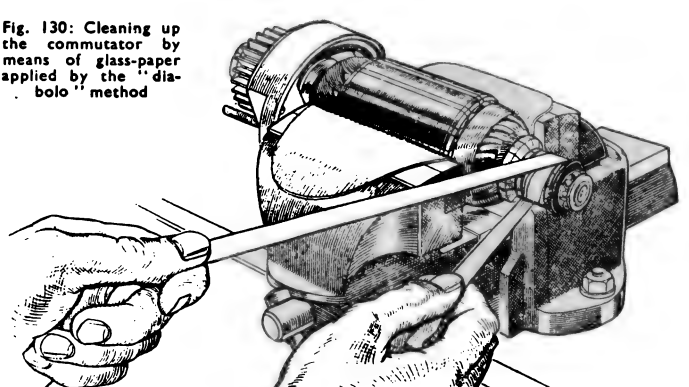


Fig. 130: Cleaning up the commutator by means of glass-paper applied by the "diabolo" method

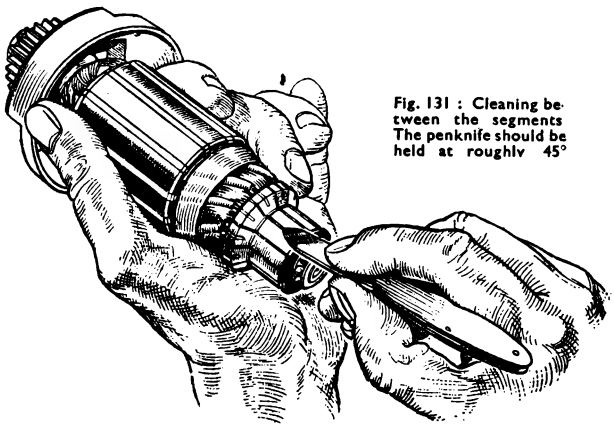


Fig. 131 : Cleaning between the segments The penknife should be held at roughly 45°

ments will be found to be riding proud. It should be cut back by means of a length of hacksaw blade ground until it is thin enough to slip into the slot. Care must, of course, be taken to ensure that the commutator is not scratched.

If the brushes show signs of being greasy they should be left overnight in a bowl of petrol and then allowed to dry. New brushes will generally bed-down of their own accord, but with instruments that do not incorporate voltage control it is as well to give the brushes a good start in this direction. They can be bedded-down by wrapping glass-paper round the commutator and then, with the brushes pressed against the glass-paper, rotating the armature spindle in the direction in which it is driven. In cases where the commutator is not accessible a method which can be adopted is to press the new brush directly on to the commutator and turn the spindle a few times. On the withdrawal of the brush it will be found that the areas over which it has been bedding are slightly glazed. These portions, and these only, should be eased down a trifle with fine glass-paper wrapped around a pencil. Replace the brush and rotate the armature again. Continue the easing of the high-spots until the brush is bedding-down over the whole of its business end.

If ever a fibre pinion in a Magdyno shears and has to be replaced, always clean out the teeth of the other pinion to remove fibre dust. The amount of grease needed for this form of drive is small. The grease, however, must be of a special type. In no circumstances whatever should ordinary grease such as is employed for the greasers on the machine be used. The correct grease for both the pinions and the ball bearings of a dynamo is Price's H.M.P., that is, Price's high-melting-point grease. Avoid over-greasing; packing the space around the top pinion and the actual races is ample—just fill the cages of the latter and no more.

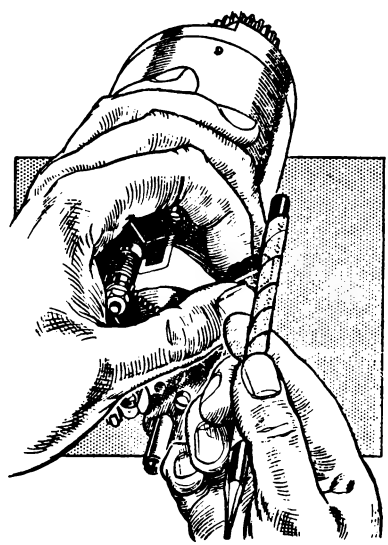


Fig. 132: Easing down high-spots on a new brush by means of a strip of glass-paper wrapped round a pencil

We have not referred to refitting the dynamo armature. One important point here is that when you slip it back you make sure that all field leads are clear of the winding. They have to be deliberately placed out of the way in certain cases. When reassembling, see that all screws are really tight, though avoid using so much pressure that there is any chance of them shearing. The cut-out, if incorporated with the dynamo, must be tight on its base—the fixing screw in the case of the old Magdyno is a connecting-point between the positive terminal and the cut-out. See that the nut on the back of the cut-out is tight and that the locking washer, with its little tag, is in proper order and doing its appointed job.

The cut-out is a device that should never be "adjusted";

except by the maker's service stations. Its adjustment is highly critical. Not only is there the question of the voltage at which it should cut in, but also that of the voltage at which the points separate. If the nickel-silver cut-out points are dirty, clean them carefully with a *very* fine file or fine glass-paper. The points are flat—not convex, like many magneto points.

In the case of the Magdyno that has a detachable " Dyno " fixed by a strap, tighten down this strap carefully. If it is not tight the screwed dowel that prevents the dynamo rotating is liable to work to and fro and cause wear in the hole in the dynamo end-plate. When the drive of a detachable " Dyno " is noisy and there is no question of dirt enmeshed in the teeth, the trouble is almost certain to be lack of care in this direction or dirt between the dynamo and the surface on which it is supposed to bed.

As a rule, a high output with a dynamo not fitted with battery-controlled charging is the result of the third brush—that is, the control brush—sticking in its box, vibrating, or being worn and therefore not held properly pressed against the commutator. Increasing the spring pressure will usually effect a cure.

A possible cause of low output is trouble in the switch (it is assumed, of course, that there are no loose connections or worn or sticking brushes, that the commutator is clean, and the battery is in order). Make sure that the spring triggers in the switch are coming into proper contact with the terminal posts, and that no insulation is becoming clipped between a terminal post and the contact—you might, as the result, be charging at half rate when by rights there should be full charge.

When the Needle Oscillates

One of the most puzzling troubles is that which results in the ammeter needle oscillating violently when the motor cycle is on the move and the lights are on. Generally, the cause is simple ; it is merely that the lead to the rear lamp is chafed and causing an intermittent short as the cable swings or vibrates. Please note, however, that

a *certain* amount of ammeter needle oscillation is often caused by engine vibration.

If by chance one cell of a battery is dud, have the battery replated or fit a new one ; it is inadvisable to carry on with the faulty battery, because there will be arcing at the cut-out points.

Now for a few matters concerning voltage-control sets. The first is how to tell whether the set is working satisfactorily. If the ammeter shows no charge there is reason to worry. By rights there should always be a slight charge showing on the meter even when the battery is well up—assuming that the engine is turning the dynamo over at what may be termed a " charging " speed. There should be a sort of trickle charge of anything up to two amperes. Equally there is something wrong if the ammeter continues to show a high charge for hours on end with the lights off.

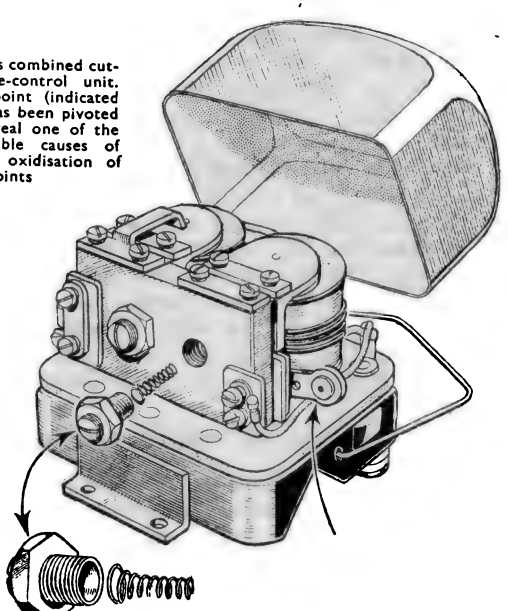


Fig. 133: A Lucas combined cut-out and voltage-control unit. The regulator point (indicated by the arrow) has been pivoted outwards to reveal one of the very few possible causes of failure, namely, oxidisation of the points

With voltage control there is a tendency to leave the battery to its own devices, because it so seldom needs topping-up. The regulated voltage control sees to it that the distilled water is not boiled away. All the same, a hydrometer should be used every now and then, just as was the case with the older type of set. This provides easily the best clue as to how everything is functioning—much better than a voltmeter. With a first-class hydrometer one can tell in a minute what state the battery is in; whether it is fully charged and whether each cell is all right. This instrument and the ammeter reading provide the information that is needed.

If you find by means of the hydrometer that the battery is fully charged, yet the ammeter shows that the dynamo is still pumping large quantities of amps. batterywards, the chances are that the points of the regulator unit are becoming welded together and that you are the cause of it. Immediately check the wiring at the dynamo end. See that you have not inadvertently crossed the dynamo field and dynamo positive leads. This point is most important, because crossing them over will result in the points of the regulator becoming badly overheated—so much so that they are eventually welded together and the complete unit burns out.

The regulator unit is normally sealed by the factory. It contains both the voltage regulator and the cut-out, and in ordinary circumstances should never be touched. However, if you are out on the road with a long run ahead of you and the dynamo is definitely not charging it is just possible that the fault lies in the regulator unit—yes, even with a brand-new motor cycle. This possible but unlikely cause is oxidisation of the regulator points. The self-same sketch that shows the regulator spring reveals a pitted point drawn from "life". That pit mark in the middle acted as a perfect insulator.

Should the very unlikely happen and you are, as mentioned, on a long run, the thing to do is to work a piece of fine emery cloth to and fro between the points. This is a get-you-home scheme; afterwards the points must be cleaned up really properly or replaced with new ones.

This, incidentally, is about the only possible way in which the regulating unit can cause there to be no charge with nothing obviously wrong.

Should you live in the backwoods, hundreds of miles from the nearest service station, and have to adjust the regulator yourself, bear in mind that the adjustment should be such that the open-circuit voltage is not set at more than 7.8 ; this is the maximum. If the open-circuit voltage is excessive the shunt winding may overheat and burn out.

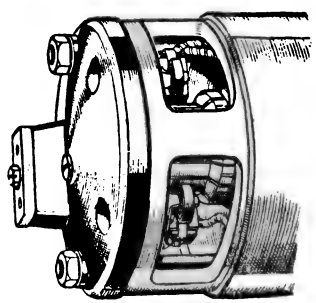


Fig. 134 : Non-adjustable springs made of flat-section wire are used to press the two brushes against the commutator of this design. Note how the cutaway yoke allows easy access to the brush gear and commutator

" When should a new brush be fitted to a Lucas constant voltage control set ? " The answer is, " When the top end of the brush is about half-way down the slot in the side of the brush box, for then the spring pressure has started to weaken."

Next, do you know what to do if the battery is faulty and you want to set off on a run ? Or if you wish to use the machine without the battery in position ? In both cases the thing to do is to disconnect the positive lead that runs from the head lamp (or panel) to the battery—assuming you have not already done so—and, after swathing its end in insulating tape, fix the lead to some frame member so that it is out of harm's way. This lead, which in Lucas c.v.c. sets is coloured yellow and black, must not make electrical contact with any earthed part of the machine.

If the battery goes phut, run on direct lighting, disconnecting the positive lead as mentioned above. A 4-volt battery must not be employed, otherwise the regulator will spend its time trying to turn the 4-volt battery into a 6-volt one, and, on a very long run, the probable

result is that the points of the regulator will become welded together and the regulator burn out.

A journal-type ball race is fitted at the driving end of the dynamo portion of the latest Lucas Magdyno. Stripping the instrument is not quite straightforward even when the pinion has been removed, for a ring nut will be found on the exterior at the driving end. This nut is recessed, and not very much of the flats stands proud. However, a very thin $\frac{3}{8}$-in. set-spanner will do the trick if care is taken. The armature can be held stationary by gently clamping the driving end between fibre or other soft vice clams.

Removal of this ring nut enables the ball bearing to be packed with H.M.P. grease reasonably satisfactorily without recourse to stripping the whole instrument.

Now it only remains to say a few words about the shock absorber in the gear drive. The two drawings (Figs. 129 and 136) show the construction. In the second an offshoot of the

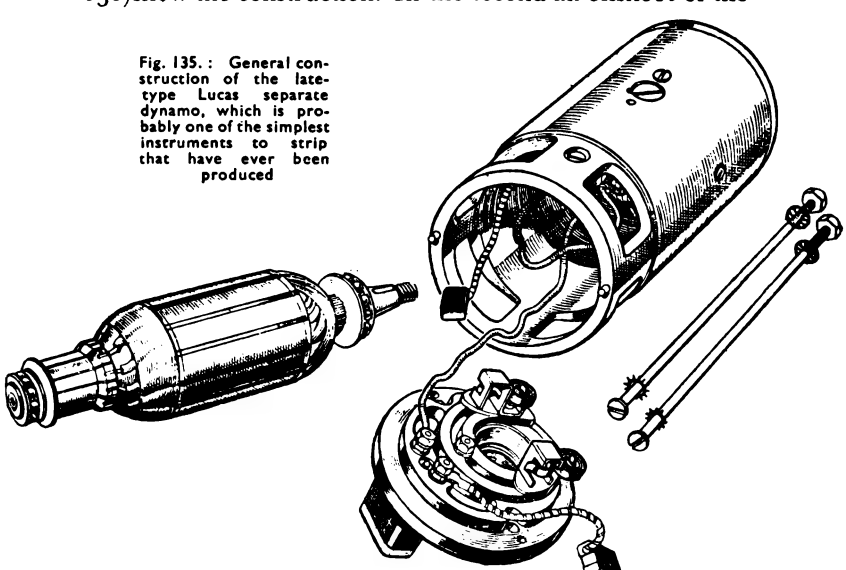


Fig. 135.: General construction of the late-type Lucas separate dynamo, which is probably one of the simplest instruments to strip that have ever been produced

main drawing shows the locking washer ; one of the most important things in connection with this spring-loaded drive is that the locking washer is in sound order. If there is any possible question of the locking tags starting to crack, fit a new washer.

Naturally, the shock-absorbing action depends upon the pressure exerted by the star spring. The nut

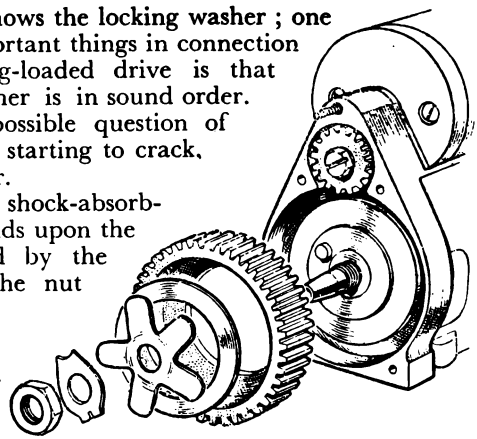


Fig. 136 : General construction of the ingenious Lucas shock-absorbing clutch

must, therefore, be tightened to a degree that gives a definite pressure. What they do at Service Depots is to use a long, thin steel arm a foot in length, and apply to the end of this arm a spring balance. The nut is tightened to such a point that the drive will just slip if a pull of about 8 lb. is applied to the spring balance. For this test and for tightening the nut the pinions are, of course, locked by means of that little diamond-pointed tool. A suitable steel arm that will encircle the nut and go over or against the dowel pin can be made up fairly quickly by any amateur or, alternatively, it is possible to employ a length of steel rod specially bent.

Focusing the Head Lamp

Various focusing devices for the head-lamp bulb are in current use. In old-type Lucas head lamps the bulb can be set in any one of three positions, there being three pairs of slots to accommodate the pins on the bulb. The plan in this case is to try the bulb in each position and see which gives the best driving light.

In these days most lamps have an adjustment so fine that the bulb can be set to the tiniest fraction of an inch. One " fine-adjustment " focusing device consists of a

split holder, with strap-type clip and screw, that enables the bulb holder to be moved backwards or forwards relative to the reflector. In another case the actual bulb holder is threaded on the outside and can be screwed inwards or outwards. This type is easily detected because on the lamp shell side of the bulb holder there is a spring ring with a pip on one end that registers with a slot cut in the screwed-in portion. This pip must be lifted out of the slot before you try to rotate the actual bulb holder. When focusing is accomplished see that the pip duly goes home in the slot.

Since different makes of bulbs vary somewhat as to the exact position of the filaments it saves time and trouble if one always uses the same make and type of bulb.

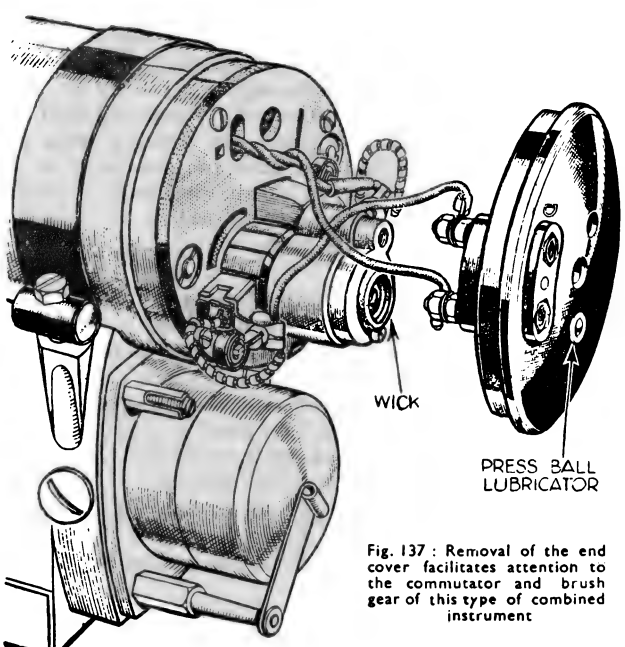


Fig. 137 : Removal of the end cover facilitates attention to the commutator and brush gear of this type of combined instrument

Focusing of the head lamp can usually be carried out perfectly satisfactorily at home. Place the machine a measured ten yards from a blank wall, with the machine propped up by means of, say, bricks underneath the foot-rests, and set at right angles to the wall. Then measure the height of the centre of your head-lamp glass from the ground, and with a piece of chalk mark a spot exactly the same height on the wall. Should you desire a straight beam this latter will be the centre of the main beam; if you are one of the courteous folk who like to use a depressed beam and thus avoid dazzling others, mark a spot one fifth of the height of the head lamp below the chalk-mark that has just been made—this, of course, will mean that the central axis of the beam (neglecting fork deflection) will strike the ground, if level, fifty yards in front of the machine.

The modern type of head lamp fixing is not very rigid laterally, and sometimes the head lamp will be found to be set to one side owing to the lamp supports having on some occasion or other been bent sideways. Assuming that the wheels are arranged in line (lock the steering with the damper, if fitted) and that the machine has been set at right angles to the wall, it will be immediately apparent as to whether the lamp fixings need resetting by bending, since if they are "out" the beam will be to the left or right of the chalk-mark.

Next set the lamp as regards its angle in the vertical direction, and then adjust the bulb either towards the reflector or away from it, until the light is the size of, say, a dinner plate and as free from shadows as possible. A short series of experiments will soon result in your finding the adjustment that gives the best possible position of the bulb, but do be wary of touching the polished side of the reflector any more than is absolutely essential.

This accomplished, check off the setting of the lamp to see that the centre of the beam is now really hitting the chalk-mark. Carry out a final check after the fixings have been made dead tight.

If by some ill-chance the reflector does become smeared with your fingers. polish it with a really soft, clean cloth

or a piece of clean chamois leather. Fine jewellers' rouge may be employed if the reflector is seriously discoloured. Metal polishes are not recommended because normally they have a tendency towards slight acidity, though the merest spot of " Bluebell " can be used with success, but take care to clean it off in its entirety afterwards.

One final word before this chapter ends : A frequent cause of trouble is the chain drive. The average rider looks after his primary and secondary driving chains, but never his so-called magneto chain. This must be free from uneven stretch, correctly adjusted and running on sound sprockets. Check these points and see that your chain has approximately $\frac{3}{16}$in. total movement in the middle of its run—not merely at the position at which the sprockets happen to be, but when they are in every conceivable position. And do not, in any circumstances, tap the sprocket home on the taper on the magneto spindle—more bearings are ruined in this way than in any other.

CHAPTER 36

THE MAGLITA

Care and Maintenance of a Widely Used Instrument

A DESIGN that is out of the ordinary is always liable to get people guessing. This applies to the Maglita ; it is on lines peculiar to itself, and for this reason many users, in spite of its comparatively simple construction, find themselves at sea when it comes to care and maintenance.

As all who possess machines fitted with the Maglita know, this instrument has a single armature—the lighting armature—but instead of electro-magnets providing the field there are two permanent magnets : straight bars of cobalt steel, one on each side of the instrument. The armature carries in its drive-side end plate a cut-out working on the centrifugal principle, and at the other end a commutator, then a ball race, and, finally, a cam of large bearing surface—the contact-breaker cam for the ignition side.

The laminated pole shoes that form the armature tunnel are extended upwards and connected at the top by a laminated bridge-piece on which are wound the ignition coils, which therefore have the great advantage of being stationary. As it rotates the lighting armature acts as an inductor ; it causes reversals of flux in the laminated bridge piece and thereby induces alternating current in the primary ignition winding.

Since the field would be distorted at high speeds, and this would affect the ignition, a " corrective " has to be applied ; this is accomplished by means of a special winding—the compensating winding. This is connected to the negative brush of the dynamo, and the lighting current can flow to earth in two ways : it can either go

via the compensating winding or via the contact-breaker points, when they are closed, but it cannot go direct.

There is an interesting result of this. When the dynamo is charging we are only partially dependent upon the reversal of flux in the bridge piece for the ignition current —the dynamo is helping, and therefore by switching on to charge we improve the spark at high engine speeds.

The set relies on earth returns in the normal way, and while there is no question of reversed polarity through a bad earth in a permanent-magnet generator such as this is, a poor earth will mean a poor compensating effect. Therefore a proper earth lead running from the head lamp or switch to the frame of the machine is desirable.

The Speed of the Maglita

One point which will be known to most users is that the instrument is always driven at engine speed, and not at half engine speed, as is the case with a magneto on a four-stroke. This means that for a given movement of the advance-and-retard mechanism the timing of the spark is only altered to half the extent it would be with a half engine speed instrument. As with all normal-type magnetos, the Maglita provides the best spark in the fully advanced position. This leads us to an important little point. Underneath the brass timing or advance-and-retard yoke, which is around the contact-breaker cam, will be a found a set-screw with a large head, and at the business end an eccentric pip ; this is the timing screw, and not only must it be kept tight, but if removed it must always be replaced with the same washers or shims as it had originally—otherwise the timing will be out and the ignition may even cut out entirely in the advance position.

While we are on this question of the timing the cam is only a push fit on the armature spindle ; it is keyed to the spindle and held in an endways direction by an O B.A. screw in the end of the spindle. This screw or stud must be kept tight or the commutator may start to float about. And it must not be used as a means of holding the armature stationary when the Maglita driving sprocket

is being replaced, since in view of the screw's size there is a big chance of it shearing off.

Actually, there should never be any trouble about fitting the sprocket, since special care is taken in the manufacture of the securing nut and the spindle thread to see that they are an easy fit, with a result that, if the tapers are clean and dry, the sprocket can be pressed well home and will then hold the spindle while the nut is being tightened. Of course, if the nut is tight the thing to do is to have a die run over the threads on the spindle.

In its method of operation the contact-breaker is quite straightforward. As with face-cam types of magneto there is a little tappet working against the spring blade that carries one of the contact points. The remarks in the chapter dealing with the maintenance of magnetos apply here, but there are one or two special matters that should be watched.

First, the fixing screws of the contact-breaker must be tight, or there will be a bad contact and incorrect gap at the points. Secondly, immediately at the rear of the spring contact blade and extending upwards will be found a phosphor-bronze spring-type pick-up; this must make a proper contact with the bridge piece that is just above it, or there will be no spark, and its little fixing screw has to be tight.

If this pick-up is examined it will be seen that its three tongues or blades are bent to conform with the curve of the bridge, and it will be realized that the tongues will not stand a lot of bending, so gently is the word.

The Condenser

That is just about all that need be discussed so far as the contact-breaker is concerned. The next matter is the condenser, which is a cylindrical affair just above the bridge piece mentioned in the last paragraph.

Sparking at the platinum points, assuming that they are clean and free from pitting, is a pretty sure sign that a new condenser is needed. The actual fitting of the new one is work for the expert rather than the amateur, since it is necessary to solder the condenser to its clips.

A very hot soldering iron and a very quick action are needed. If the iron is applied for any length of time the wax in the condenser will melt and the condenser will be punctured, while, if the soldering is not properly carried out, there will be trouble with the platinum points.

There is no slip-ring with its attendant carbon brush to worry about on the Maglita, so in the normal course of events there is no reason to remove the pick-up at the end of the h.t. lead at all. Should it be detached it is necessary to see that the lead from the secondary winding goes properly home in the taper hole in the pick-up, that any rubber bungs in the fixing-screw holes are duly replaced so that everything is watertight, and that the surface of the pick-up that beds on the instrument is coated with a good insulating varnish.

Weatherproofing

Weatherproofing is all-important. When the top of the Maglita is removed, care must be taken to see that the special cork packing washers go back properly.

If the starting is good, but there is misfiring at high engine speeds, look for a breakdown in the insulation at the negative brush—a crack, say, in the moulding. The reason for the missing in such circumstances is that the compensating winding is not functioning.

Another possible cause of misfiring is the dynamo trying to charge the " wrong way round ". To check, remove the charging or positive wire from the left-hand terminal of the Maglita, and if that cures the trouble run over all the leads carefully. Connecting the battery up wrongly should be guarded against, since the effect is partially to demagnetise the magnets. One last item before we leave the magneto side of the instrument : it is a good thing every now and then to apply the merest smear of oil to the cam.

As with all generators, it is most desirable that the user keeps a close watch on the various cables and the tightness of the connections. If a failure to charge is due to the generator the fact can be checked quite easily

by the following method. Connect a lamp bulb across the dynamo terminals and start the engine ; the bulb should light brilliantly at about 1,500 r.p.m. If it duly does so, the answer is to be found in the wiring or the switch ; if it doesn't, check over the brush gear.

The Brushes

This brings up another important matter : the two brushes, while they look much the same, are of two different grades. The positive brush is marked CM5H and the negative EG O. This arrangement must be adhered to. The former is the harder brush and has a scouring action, while the latter has a lubricating effect. As a result of this it is seldom, if ever, necessary to clean the commutator.

Should the battery fail on a machine fitted with a Maglita, one can carry on with the generator supplying the lamps direct, provided that the engine speed is kept low. With an 18-watt bulb in the head lamp there should be no likelihood of the bulbs burning out so long as the engine speed is always below 2,500 r.p.m., which, if the machine has a 5 to 1 gear, is equivalent to roughly 38 m.p.h. in top.

Now we dive into deep water, for we have come to the question of removing the armature. There is one difficulty here : if the magnets are allowed to become demagnetised they cannot be remagnetised with a normal magnetiser, and it is a job for one of the official service depots. In addition, it is not too easy to apply a satisfactory keeper, and thus prevent loss of magnetism. Therefore it is necessary to stress that the amateur is generally well advised to entrust to a service depot any work that involves the removal of the armature.

Assuming that the ignition coil is not removed—in other words, that the bridge piece across the pole-shoes is in place—one keeper will do the trick, but it must be of a special shape depending upon the type of Maglita, and it should be properly made.

On the late type of instruments, those of Lucas manufacture the magnets are bevelled off at the top, and

A special form of soft-iron keeper has to be used in connection with a Maglita. Fig. 138 shows a keeper suitable for late-type instruments. Face A has to mate with the bevelled upper surface of the magnet, while Face B is arranged to make contact with the laminations immediately below the magnet. In the case of the older type of Maglita the laminations at the top of the instrument are accessible once the top cover has been removed, and a keeper of the form shown in Fig. 139 should be employed

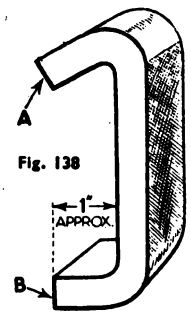


Fig. 138

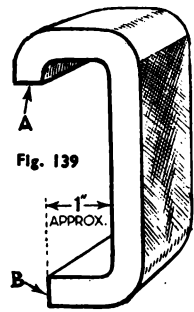


Fig. 139

one cannot get at the laminations at the top ; therefore, the upper end of the keeper has to be applied to the bevelled portion of the magnet. The keeper should be fashioned out of soft iron by, say, a blacksmith, and have a cross-section of about two square inches. Fig. 138 shows a type of keeper that can be used. The end at the bottom is arranged to fetch up against the laminations at the bottom of the instrument, just below the magnet. Fig. 139 shows a type that can be employed with old Maglitas on which the laminations are accessible at the top.

Removing the contact-breaker and the generator brushes is quite straightforward, but if the advance-and-retard is to be taken off note should be made of the fact that it is located endways by a simple spring ring, which can be slipped out of place with the aid of the point of a bradawl.

Now comes a point that is liable to be overlooked : the contact-breaker side ball-race is held in a split housing, and the little clamping screw that will be found underneath must be slacked off. At the other end of the instrument there are just the fixing screws, and then, with the keeper in place, the armature can be carefully tapped out of its tunnel.

To get at the drive side bearing and the cut-out the end cap has to be removed with a peg spanner.

When the armature is out check off the tightness of the leads, especially if the generator has been failing to charge, and, if necessary, resolder them in place. There are four

leads, and it is a simple matter to check off whether the winding is in order. On one pair of leads one should find a resistance of 3-4 ohms, and on the other a dead short.

The cut-out is of simple construction, but when the armature is out it is as well to apply the slightest smear of sewing-machine or three-in-one oil to the brass locking bolt. If the cut-out has been sticking, see that the surfaces of the brass locking bolt are highly polished, so that it slides freely, and that it is nicely radiused at the point indicated in Fig. 140. The spring on the locking bolt is of definite strength, and, therefore, should not be extended.

When reassembling remember that the insulating disc always goes next to the cut-out.

Use H.M.P. Grease

H.M.P. grease should be used for packing the bearings ; this will last for some ten thousand miles. Ordinary grease is, of course, unsuitable.

In putting back the armature care must be taken over the tightening of the screw in the split housing. It should be just taut—if it is tightened up hard the outer race will be distorted.

Two final items : Make a habit of switching off when

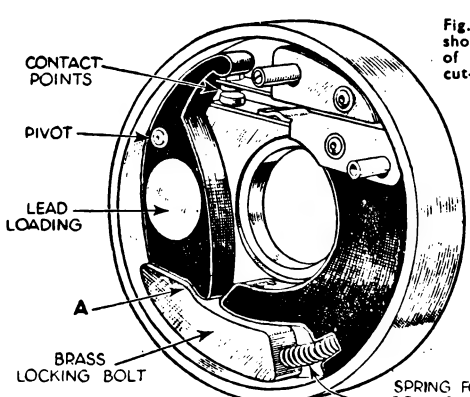


Fig. 140 : This drawing shows the construction of the centrifugal-type cut-out. The brass locking bolt should have highly polished bearing surfaces and be smeared with a trace of sewing - machine oil, so that there is no possibility of it sticking. It is desirable that the curve at A be nicely radiused

you stop, just in case the cut-out should stick, and if on starting off slowly with the switch in the charge position nothing happens, in spite of the engine speed rising above the normal cutting-in speed, just rev up the engine momentarily—it may be that the cut-out has not had the twitch necessary to set it in operation ; but this does not mean scream the engine up to 6,000 r.p.m. !

CHAPTER 37

TWO-STROKE EFFICIENCY

The Silencing System : The Piston : Mixture Strength : Air Leaks : Bearings : Overhauling : Lapping-in

TWO-STROKES are so simple that they might be thought to be uninteresting from the maintenance standpoint. But, as a two-stroke enthusiast remarked not long ago : "They are so simple, yet you never seem to cease learning about them ".

The two most important factors concerning two-strokes are (1) you must keep the silencer clean, and (2) since everything depends upon the piston the best results can only be expected if care is taken during the running-in period.

The importance of a clean, unobstructed silencing system needs emphasising because it is a matter that is very frequently overlooked. Happily, the deposit in the silencer of a two-stroke is of an oily nature ; unhappily, it is also of such a nature that it is liable to cause choking if left for long periods. Cleaning out the silencer should be looked upon as a task that is quite as necessary as decarbonising the engine, and, if the gas passages are of small area, required just as frequently.

Because of its " wet " state the deposit is generally removed quite easily. Much can, as a rule, be wiped off, but assuming that none of the system is made of aluminium the caustic soda method is the best to adopt. This is described in Chapter 30 ; you merely place the parts in a bath containing water and ordinary caustic soda, such as you buy at the local ironmonger's or oil stores, say, three pounds of the soda to every gallon of water. Leave the bits and pieces overnight and in the morning wash them with plenty of running water, and the probability is that they will be as clean as when they were new. The effect of the soda is accelerated if the

solution is kept hot, and this is worth bearing in mind in the unlikely event of the deposit proving tenacious. Remember that the solution is strongly irritant to some skins, and must not be allowed to get into the eyes.

The exhaust pipe can be dealt with by immersion, but if it is too long for the bath either one end can be plugged up with a cork and boiling solution poured in and left a few hours, or a pan scrubber can be attached to the middle of a strong piece of cord and pulled backwards and forwards through the pipe, thus scraping off the deposit.

It has to be remembered that the piston of a two-stroke performs a variety of functions. In addition to transmitting the power to the connecting rod it acts as a pump and also opens and closes the ports. Compared with a four-stroke the piston is normally fitted rather " tight ", or, in other words, the clearance between the piston and the cylinder walls is not so great. When all this is borne in mind, with the twin facts that there is an explosion every revolution of the crankshaft, and that the piston, if it has a deflector, is apt to expand unevenly, it will be readily understood that it is highly desirable to give the engine every chance of bedding down comfortably.

Running-In

Running-in is discussed in considerable detail in Chapter 18. What applies to four-strokes is applicable with far greater force to two-strokes, and those who take the trouble to drive lightly during the initial stages will be repaid with a better performance in every direction, including that of longevity.

Briefly, the points in connection with running-in are : first, to give the engine an excess of the correct oil rather than be niggardly with it ; secondly, to err on the side of a rich carburetter setting ; and, thirdly, at all times to let the engine turn over lightly and smoothly. There should be no running the engine for lengthy periods in neutral, no slogging hard up hills, and no screaming the engine in bottom or second gear. A fourth and most important point is that the engine is gradually given more work to do.

The question of mixture strength is worthy of close study. A rich mixture will, of course, give excessive four-stroking at low engine speeds, but it is much better to have the mixture on the rich side than to set it at all weak. A weak mixture does not necessarily give fuel economy; it may even result in the consumption being higher than it need be because of the larger throttle opening required for a given performance.

But that is not all: a weak mixture spells a hot-running engine, and high temperatures spell distortion of the lop-sided piston and, possibly, plug failure owing to pre-ignition—there is an explosion every revolution, remember. Particularly is it desirable to set the mixture control towards "rich" or close the air control a little when the machine is being driven hard. This will help to prevent the piston partially seizing or the engine locking-up or slowing due to the plug being unable to withstand the heat.

Mixture and Sparking Plugs

If this so-called drying-up should occur, and if it is a certainty that the engine is receiving its proper quantity of oil and is not seriously in need of decarbonisation, then thoughts automatically turn to the subjects of mixture strength and sparking plugs.

In the matter of plugs the best policy is to consult the recommendation chart of the selected plug maker and use none but the particular plugs that are specified. If, by some ill-chance, trouble ensues and you are quite sure that the engine and the carburetter setting are in every way correct, drop a line to the plug maker, stating all the symptoms, and asking for advice. With some high-efficiency engines one and the same plug will not suit both about-town work and full-throttle riding on the open road; this applies to the super-sports type and seldom to any other.

In cases of weak mixture the fault may not lie in the carburetter setting. A two-stroke has many points at which there may be air-leaks to upset the mixture strength. The following is a list: the carburetter fixing, the cylinder base, the crank case joints and the main bearings. A

faulty washer, burring of the aluminium at a joint through careless stripping of the engine or merely ordinary wear-and-tear of the main bearings may cause sufficient air to be induced to render the mixture too weak.

The trouble is to determine where, precisely, the leakage is occurring. There is, however, one simple and effective method. This is to run the engine slowly with the machine on the stand and squirt petrol on to each of the points in turn. A fountain-pen filler will form about the best squirt, though, of course, even "kid-brother's" water pistol will do the trick. Should there be a leak at a particular point the fact will be apparent, since the note of the exhaust, and, probably, the speed of the engine, will alter quite appreciably, owing to the fact that the petrol is being drawn in through the leak.

If the main bearings are at fault, and there is readily-detectable up-and-down play at the crankshaft—side-play does not matter—then new bearings are indicated.

This, however, is only likely to be the case with an engine that has seen a lot of service. It is far more probable that one of the joints is leaking because an old, faulty washer has been replaced or the joints have been put together either dirty or without being smeared properly with a suitable jointing medium.

Remaking a Joint

Real care should be taken over remaking a joint—it is not just a matter of the possibility of oil leaking as with a four-stroke. "Any old piece of paper" is definitely not good enough for washer-making, and for anyone save those meticulously careful people who trouble to see that they have cartridge paper of a suitable thickness and have the patience and ability to cut out a truly accurate washer, it is best to buy the engine maker's—they are cheap enough, and if it is a crank-case washer that is at fault it is a pig of a job cutting a new one.

Some motor cyclists prefer to smear the washers with engine oil. A tin or tube of one of the glues or special compounds advertised for the purpose lasts almost indefinitely and generally does the job very much better.

Most people are well aware that a little logic must be applied to the task of tightening up nuts and bolts when there is a number of them, as in a crank case, and even over the bolting-down of the cylinder head, since otherwise distortion is likely. The scheme is, of course, to tighten a little at a time, working from one nut to that diagonally opposite. After the engine has been run a time or two the tightness of the various nuts should be checked over afresh in case they have bedded down.

Before we leave this question of air-leaks let it be reiterated that it is desirable to see that there is none at the carburetter fixing.

The Piston and Rings

Now we come to the heart and soul of the engine—the the piston and the piston rings. We have seen that half the battle as regards the former is to run-in the engine with real care. Some famous two-stroke experts admittedly flog their new units and get their pistons to distort just as much as they will, but they follow this up with much skilled attention to the piston. Given time, most of them would much prefer to run in gently, thus allowing the internal stresses to relieve themselves without causing any serious permanent set.

Even with care in the initial stages it will often be found that a piston of the deflector type has a few high spots that can advantageously be eased with a very fine file. An extremely fine nail file will do the trick as well as anything. First detect your high spots—this is reasonably easy, since they are apparent as bright areas standing out in relief from the remainder of the piston's surface ; they are bright for the simple reason that it is the high spots that are bearing on the cylinder walls, while the remaining portions are not touching at all and are therefore dull in comparison.

Our object is to ensure that the whole of the piston walls shall do their job by pressing evenly on the cylinder. Therefore we ease the high spots, and the high spots only. Rest the piston between the jaws of the vice,

using either lead clams or a piece of cloth to prevent the jaws scratching the piston. Then work the file forward and round the piston (Fig. 141). Only a small amount of metal should be removed—it is easy enough to take off some more on a future occasion, but quite impossible to put any back !

The piston rings of a two-stroke are considerably wider than those of a four-stroke and far more important, so the question of lapping them in is well worth consideration. This helps new rings to bed down, and therefore, while by no means necessary, it is at all events a good scheme.

Lapping-In

Lapping is a simple if somewhat arduous task. The essentials are a dummy connecting-rod and some brass polish. If an old con-rod is available, drive a piece of tubing or a round piece of wood through the big-end eye to form a handle. Otherwise find a hefty old hammer handle and close to one end drill a hole of a diameter equal to that of the gudgeon pin. A jig should be made up for holding the cylinder, since it is highly undesirable

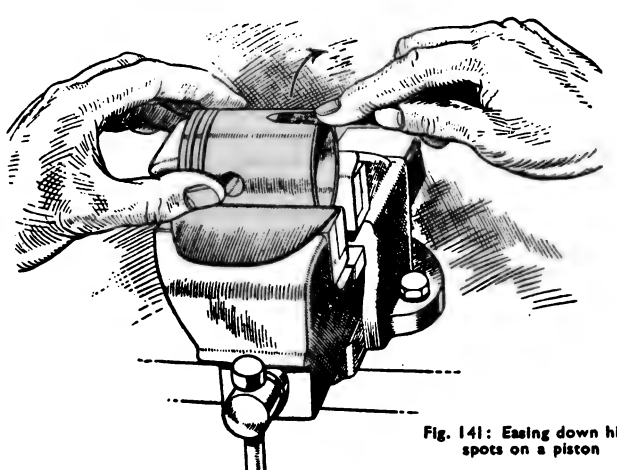


Fig. 141: Easing down high spots on a piston

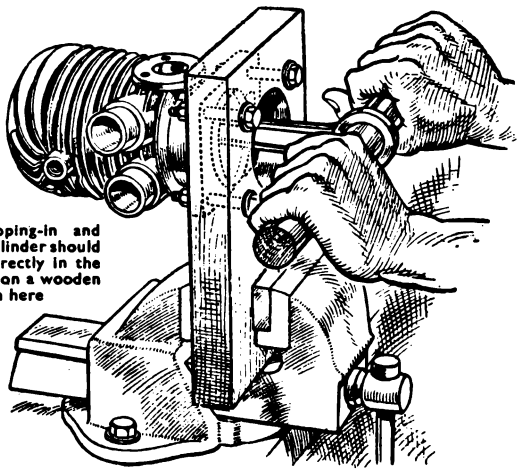


Fig. 142 : For lapping-in and similar work the cylinder should not be clamped directly in the vice, but mounted on a wooden jig as shown here

to fix it directly in the vice. This may take the form of a block of wood of the shape shown in Fig. 142.

Now with the new rings in position on the piston and the cylinder nicely clean internally and mounted in the vice, attach the piston to the dummy con-rod, smear the piston with the metal polish, and work the piston up and down the cylinder bore with full-length strokes and a screwing motion. Be very wary over the screwing action and the position of the piston in the barrel because of the possibility of the rings becoming trapped in the ports. Every now and then remove the piston and redistribute the polish. Proceed in this manner until it is apparent from the brightness of the rings all the way round that they are bedding down over the whole of their bearing surfaces.

This method of lapping applies to all engines, whether two-stroke or four-stroke, and is very useful in cases where the cylinder has become slightly scored. Even scores a couple of thousandths of an inch deep can be removed if valve-grinding paste is employed instead of the metal polish, but in such an instance the piston from the engine should not be used. Either utilise an old piston of the same size as the standard one or a dummy

piston carefully turned-up from lead. For slight scores some riders use their normal pistons, assuming that these are of cast-iron and not of a light alloy, but this, of course, means unnecessary and undesirable wear of the piston.

Decarbonising a two-stroke is straightforward, but there are one or two points special to this type of engine. First, there is the need for carefully removing all carbon from the sides of the deflector on the piston crown. Secondly, in view of the piston's many functions, it is desirable to be particularly careful not to scratch the sides of the piston. Thirdly, the inside of the piston should be scraped out every time the cylinder is lifted for decarbonisation.

Since the compression release valve spends almost its entire life on its seat, it does not need frequent attention. To grind it in every time the engine is decarbonised is a sheer waste of energy and grinding paste. Once every ten thousand miles is generally quite often enough, and then the procedure is merely that of grinding in a four-stroke valve, though, of course, less arduous.

In cases where an aluminium-alloy cylinder head is fitted, the body of the compression release should never be unscrewed unnecessarily, since owing to the softness of the head material the threads will suffer.

Mention of threads brings up the matter of sparking-plug threads, which are apt to be a little ragged at the combustion chamber end of the plug boss. This raggedness may be sufficient to cause pre-ignition, so any jagged ending to the last thread, either of the plug hole or the release-valve hole, should be removed with a bent file or scraper. Pre-ignition has to be guarded against, and it is as well, therefore, to make sure that there are no rough patches in the combustion chamber.

Many riders, searching for another "pony" or two, polish the ports with emery cloth and energy. This is useful work so long as the shape of the ports at the cylinder walls is not altered. Obviously the designer had some definite reason for the chosen positions of the ports relative to the piston's stroke, and filing away the tops and bottoms of the ports will mean that the timing of the engine is modified.

Altering the shape of ports is work for the expert only. Here a little knowledge is truly a dangerous thing, since it is easy enough to change the whole character of the engine and even to ruin its performance entirely. Therefore polish the ports, but don't alter their shape at the cylinder end.

Surprisingly, *The Motor Cycle* receives quite a number of letters from two-stroke owners who have replaced their pistons the wrong way round and are wondering whence the power has gone. So, for the benefit of the uninitiated, it must be mentioned that the steep side of the deflector should be on the transfer port side of the piston.

Another little failing on the part of novices is that they often over-flood their carburetters or leave their machines leaning right over with their petrol taps on, and thereby allow flooding to occur. If a considerable quantity of neat petrol reaches the crank case, starting is out of the question — the mixture will be too rich to explode. The remedy is to remove the draining stud at the bottom of the crank case and kick the engine over a number of times before replacing it and endeavouring to start up.

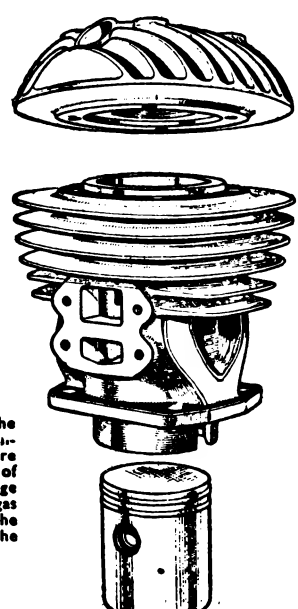


Fig. 143 : Construction of the deflectorless piston Villiers engine. The transfer ports are designed with the object of preventing the fresh charge mingling with the burnt gas from the previous cycle. The ports themselves act as the "deflector"

CHAPTER 38

TRACING TROUBLES

A Plan of Campaign and How it Saves Time

HALF the battle in tracing a trouble is to be methodical. Avoid jumping from one point to another—take matters in a definite sequence, and check only one item at a time. If these golden rules are remembered there is usually very little difficulty in alighting upon the cause, even in cases where there are no preliminary symptoms.

Of course, generally there *are* definite symptoms, and these enable the experienced to place their fingers on the cause, often without the slightest hesitation. In this chapter it is only possible to deal with troubles in theory; therefore, it is proposed to outline certain methods in the hope that those who read will gain a hint or two that will help them in their own particular worries.

As an example, we will take an actual occurrence. The machine suddenly ceased firing for no apparent reason. There were no prior symptoms of any sort—the rider had just changed gear, and the engine suddenly cut out completely. Barely had the machine stopped than the petrol was turned off; then the rider depressed the carburetter tickler. Yes, the float chamber was full, so there was no question of petrol shortage owing to a choked pipe, lack of fuel in the tank or the little air vent in the filler cap being blocked up.

Putting his hand on the throttle control cable and at the same time opening and closing the throttle the rider learned that it was not a case of a broken throttle wire. If the carburation was at fault at all, then obviously there must be dirt in the duct leading from the float chamber, or a lump of dirt completely obstructing the main jet.

Flooding the carburetter showed the duct to be clear, because petrol flowed from the mixing chamber ; and a choked jet was unlikely, since the engine had not fired on the pilot jet *or* the main jet. It was the work of only half a minute to unscrew the jet plug and jet—all was in order, so, with little more than a minute wasted, attention was turned to the ignition.

One plug was taken out and laid with its body on the cylinder and the terminal well clear. It would have been quicker to have placed a finger upon the terminal and have kicked the engine over to determine whether there was any current reaching the plug ; but the rider, having a strong objection to electric shocks even in their mild forms, much preferred to waste the few odd seconds !

Although the business end of the plug was shielded from the strong light of the sun, not a vestige of a spark could be detected either at the points or in its internal economy. Had the engine been a single and not a four-cylinder, the rider might then have pulled a trusted spare out of his pocket and have seen whether, with that in position, there was any spark. But since there were four cylinders, and all had cut out at once, there was no object in doing this—in fact, looking back on the matter, the rider now realised that the most sensible thing might have been to have given the plugs a miss entirely ! The chances were goodness knows how many to one that neither all four plugs nor the four h.t. leads were at fault, and about the only thing the inspection of the plug could have told was that the spark was a weak one.

Next the rider glanced over the leads to the distributor —it was a coil-ignition job, by the way, so the twin facts that the tell-tale light was glowing brilliantly and the ammeter showing its correct discharge rate really told that there was, without question, plenty of current reaching the distributor. Therefore, we had reached this point : something was wrong with the distributor. Off came the cover. Definitely something was wrong—the bakelite rotor had split into two !

The trouble described is a most unusual one, but the methods whereby it was traced form a good example of

the general methods of diagnosis. One has to bear in mind that an engine will run so long as : (1) there is a sound spark occurring at the plug points at the correct position of the piston ; (2) a fireable mixture is reaching the combustion chamber ; (3) the piston, connecting-rod, crankshaft and cylinder are whole ; (4) the valves, if the engine is a four-stroke, are opening and closing correctly.

By sub-dividing in this way and working in a definite sequence we save an immense amount of time. The only difficulty comes when there are several items off-colour and all of them contribute their quota to the trouble. But the man who keeps his mount in proper trim seldom experiences more than one trouble at a time, and then the chances are that the symptoms point immediately to the cause.

The Most Elusive Troubles

To judge from queries *The Motor Cycle* receives from readers, the following are among the most elusive troubles : (1) choked air vent hole at the filler cap (if air cannot get into the tank, petrol cannot flow out of it !) ; (2) contact-breaker points which appear to close, yet, actually, when a piece of white paper is placed behind them, can be seen to remain open by a thousandth of an inch ; (3) choked silencers on two-strokes ; (4) sticking valves and worn inlet valve guides on o.h.v.s ; (5) slipped magneto timing (which can be rough checked by seeing that the platinum points start to separate when the piston is at the top of its correct stroke and the magneto fully retarded) ; (6) oil short-circuiting the current at the slip-ring of the magneto ; (7) perished h.t. cables that are shorting to the frame ; (8) coil-ignition leads broken off inside their rubber casing ; (9) cracked carbon brush holders ; (10) engine seizing after a spell of hard work and then found to be quite free when the machine has coasted to a standstill.

This last trouble is probably as frequent as any. It may simply be slight piston seizure, in which case the high spots should be eased down at the first available opportunity, or it may be pre-ignition, caused by the plug

not being able to stand so much heat, an incandescent particle of carbon, some roughness in the cylinder head casting, raggedness at the end of the plug boss thread or a valve head slot, or, in the case of a high-compression engine, the use of a fuel of too low an anti-knock value. Where the fuel is at fault the impression one sometimes gains is that of some giant hand pulling the machine backwards.

It is not always possible to decide between pre-ignition and the piston drying up, for often the symptoms are, as near as no matter, the same. But where it is pre-ignition, and the recommended plug is in use and the engine is reasonably clean, it is advisable to make sure that the primary cause of the trouble is not a weak mixture.

A method employed by some riders to determine whether the apparent seizure was the piston drying up is the following. Hardly have they whipped out the clutch than they try letting it in again with the throttle closed. This they do very gingerly. If the effect is similar to that of applying the brake, they have their answer : it is the piston that has dried up and pre-ignition can almost certainly be ruled out.

Only the piston is likely to seize up and then free itself in a matter of seconds or a minute or two. A seizure of any other bearing surfaces is of a much more permanent nature and the probability is that cooling down will have little or no effect. This point is mentioned because sometimes motor cyclists wonder whether the trouble is not concerned with the gear box instead of the engine and, in particular, the piston. Actually, the chance of gear-box seizure is not one in a thousand.

The great thing in endeavouring to trace a trouble is to be methodical ; if you cannot detect what is wrong from the symptoms or from previous experience, sectionise the directions from which the trouble can emanate and then work " along the line " in a definite sequence. Avoid trying to check two items at once—adopt the tuner's maxim of altering one thing at a time and then testing the result.

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